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Historic Structure Report
Main House and Annex
Scotty's Castle, Death Valley Ranch

DEATH VALLEY
National Monument • California/Nevada



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HISTORIC STRUCTURE REPORT
DEATH VALLEY SCOTTY HISTORIC DISTRICT
MAIN HOUSE AND ANNEX

September 1991

DEATH VALLEY RANCH
DEATH VALLEY NATIONAL MONUMENT • CALIFORNIA / NEVADA

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE



Everybody wonders about the Castle – why it is and what it is. That’s what we wonder too. Scotty says it never had any beginning and it never will have an ending. And that’s about true. It certainly is far from finished and it never really started. You see, we built a garage and storeroom first, and two or three bedrooms overhead. We lived in this for a while, and it was ugly. Then we began decorating and glorifying it til it turned into a castle with an organ and a bell tower and chimes. Anyway, it makes a fine lodge when we come in off the desert, hot and dusty. It’s not nearly finished and maybe never will be. We don’t know. We build as fancy leads.

Bessie Johnson

Death Valley Scotty by Mabel (Death Valley, Castle Publishing Company, 1941), p. 156. This publication was written by Bessie Johnson in 1932 but was not published until 1941. She used the pen-name Mabel because that was Scotty’s nickname for her. Photo by George Voyta, Death Valley National Monument, 1984.

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PREFACE

This Historic Structure Report was initiated in Fiscal Year 1989. The scope of work was limited to the Main House and Annex to focus on a number of preservation problems of specific importance to those two structures, although it is recognized that many of the same concerns, as well as treatment approaches, are applicable to many of the other structures.

Of the total number of preservation concerns, a portion of them were prioritized for concentration during the FY89 HSR phase, including an evaluation of available historical materials and presentation of these, and nine of the twenty-one problem studies identified in the project Task Directive (approved January 20, 1989). An in-progress draft of the FY89 work was reviewed in November 1989 at Scotty's Castle. Region and park personnel provided an in-depth critique of the analysis and recommendations presented at that time.

Based on that review, those sections of the report were revised and expanded and the remaining study areas were developed in FY 1990. An archeological survey was conducted in April 1990 by staff of the Western Archeological and Conservation Center (WACC) and the park. A copy of the memorandum report is included in this report. This final report is the consolidation of the total effort.

Many aspects of this report, and the needs of the park, require ultimately degrees of knowledge and expertise that are beyond that of the preparers of this document, or cannot be accomplished within the present time and funding. Some investigative requirements will need to be accomplished through contracted laboratory testing or by highly specialized conservators of specific materials or systems.

The Historic Structure Report team wishes to thank the numerous park and regional office personnel who provided their enthusiastic support and assistance in the development of this study: Tom Mulhern, Regional Chief, Park Historic Preservation, for the support for preservation efforts at this resource; Craig Kenkel, Regional Historical Architect, and Diane Nicholson, Regional Curator, for their in-depth review; Gordon Chappell, Regional Historian, for review of the history; Superintendent Ed Rothfus, Park Resources Chief Jeff Aardahl, Unit Manager Jack Fields (now retired), Maintenance Foreman John May, for their administrative support, review and input; Curators James O'Barr and Judd Tuttle for their enthusiasm in providing archival material; Don Creech, Ed Meisner and all the maintenance and preservation staff for their investigative assistance and fine work; and especially George Voyta, whose expertise, knowledge and familiarity with the resources entitles him to be an author of this report.

R.L.C.
September 1991



Photo by Jack E. Boucher, Historic American Buildings Survey,
HABS No. CA-2257 AA-33, ca. 1987-89.

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SUMMARY

PURPOSE

A historic structure report (HSR) is prepared "whenever there is to be a major intervention into historic structures or where activities are programmed that affect the qualities and characteristics that make the properties eligible for inclusion in the National Register" (NPS-28, 2.21). Interventions are in fact anticipated for the Main House and Annex of Scotty's Castle, and activities are being programmed for the preservation of these buildings. The primary purposes of this report are to assess the need for these interventions and activities, evaluate alternative methods of implementation, and to recommend the best possible strategy to achieve management goals while protecting the qualities and characteristics of the resource which make them eligible for inclusion in the National Register of Historic Places.

Until a development concept plan (DCP) is prepared, the April 18, 1989 Record of Decision for the General Management Plan/ Environmental Impact Statement (GMP/EIS) provides the basic management directive for this report. It states:

The interpretive period for furnishing the first and second floors of the main house and the second floor of the annex is 1934 through 1941. This does not preclude, however, the use of earlier or later data where none exists for the interpretive period. The structure exteriors and grounds of Scotty's Castle will be managed and preserved as they appeared during the early 1950s through Scotty's death in 1954, including alterations made to Windy Point for his burial and the grave site memorials which followed. With respect to the historic resource study/historic structure report, the study would also determine other possible periods of significance for the structures and grounds at the Castle and Lower Vine Ranch.

"That management policy will be continued until further studies are completed" which may provide basis for modification. "Recommendations and decisions about adapting buildings for interpretive, exhibit, curatorial, or management purposes (including living quarters for employees) would be postponed until" historic resource studies, historic structure reports, interpretive plans or other studies are "completed for the entire complex....This information is essential for the preservation of the structures and grounds within the historic district" (page 42 and "Record of Decision" memorandum dated April 18, 1989).

The Cultural Resources Management Plan points out that Scotty's Castle has "high interpretive values" and emphasizes the need for "continued preservation maintenance" [Draft CRMP, by Krista Deal, Western Archeological and Conservation Center, NPS, 1987].

The purpose of this report is to assess the condition of the buildings and recommend the appropriate preservation measures including repairs and other treatments as necessary to properly manage the property for the benefit and enjoyment of monument visitors.

IDENTIFICATION OF STRUCTURES

Death Valley Scotty's Historic District, located at the northeastern end of Death Valley National Monument, includes 33 structures on the National Park Service (NPS) List of Classified Structures (LCS). The district is included in the National Register (date of entry July 20, 1978) and is being evaluated for possible inclusion as a National Landmark. The central feature of the

district is Scotty's Castle itself, including the Main House and Annex buildings which are connected by a courtyard. Together they are designated as follows:

ID LCS # 00250

Historic Structure # SC-02

Management Category A: Must be Preserved

Proposed Treatment: Preservation

The Main House began as a simple rectangular structure constructed in 1922. It was lavishly remodeled, virtually rebuilt, to include the companion Annex between 1926 and 1931. The style has been called Old Provincial Spanish, but is a blend of period revivals and Southern California vernacular of its time. The buildings are built of concrete and wooden frame and are finished with a cement stucco and red tiled roofs. Together with their towers, courtyard and second level connecting bridge, they include over 30 rooms on two main levels, a total of over 8,000 square feet, plus an array of subterranean tunnels.

The complex, originally called Death Valley Ranch, was built for the Chicago millionaire Albert Johnson. Construction engineer Matt Roy Thompson, designer Charles A. MacNeilledge and architect Martin de Dubovay were employed for the 1926-31 modifications and embellishments.

PRESENT AND PROPOSED USES

The first and second floor of the Main House and the second floor of the Annex function as a preserved and furnished 'house museum'. Portions of the first floor of the Annex and the basement of the Main House serve curatorial storage, library and office functions for the NPS curatorial and interpretive staffs. There is also office and support space in the basement of the Main House for the staff of NPS preservation specialists who assist in maintaining the historic structures. The basement and tunnels under the complex are primarily utility and building service/storage areas.

Interpretive tours are conducted by NPS interpreters for hundreds of visitors daily and amount to approximately 100,000 house walk-throughs per year.

Although preservation and interpretation of the complex will continue to be the primary functions, some changes in the location of curatorial and support functions and some administrative and operational controls are proposed to improve the environmental controls within the complex for enhancement of curatorial object preservation, historic building fabric preservation and interpretation.

PROPOSED CHANGES IN USE (SUMMARY)

Changes in the use pattern of the Main House and Annex, as well as other structures, are discussed in a separate chapter of the HSR (Building Uses), drawing on discussion of this subject in the GMP and Interpretive Prospectus. In the future, relocation of various support functions are proposed to more fully enhance interpretive and preservation objectives.

PROPOSED TREATMENTS (SUMMARY)

The treatments recommended in this Historic Structure Report are outlined in the table at the end of this section. A coordinated program of treatment implementation is necessary but flexibility of application is necessary to adjust to variable multi-year funding. Synchronization of treatments is necessary to minimize handling and storage of furnishings, disruption of visitor tours, and so that execution of all treatments required in any one building room or portion of the buildings can be done at one time. The reality of variable multi-year funding as well as other factors will require flexibility in treatment execution. To control the quality of the work and assure protection of building fabric, it is recommended that execution of as much of the work as is appropriate be accomplished by the park preservation staff, which is trained in preservation requirements and methods. Because of the remote location and lack of any housing for contractor personnel, execution by the park preservation staff is also more cost effective. Some portions of the work can be executed by construction contract which is beyond the capability of the park staff and when preparatory work has been completed. See the individual report chapters for detail of the recommended preservation, restoration, replacement or repair treatments, which include the groupings in the accompanying table summarized by recommended priority, with estimated costs shown for that priority group.

The estimated costs of the treatments recommended have been generated from similar activities undertaken elsewhere as well as estimated by direct analysis of this project. The figures provided are class "C" estimates at 1991 costs.

IMPACT SUMMARY

The treatments recommended in this report will have effects on the cultural resource; however, it is intended that the treatments will result in benefits providing for a higher level of preservation of the resource than is now provided. Some proposed work will include actions that would be considered adverse effects. For example, installation of mechanical equipment for interior climate control will require some removal of building fabric for air distribution ducts and registers. One of the most important design criteria, however, is that the system be designed to minimize these effects, both physically and visually. Those adverse effects will be mitigated by providing an improved environment for the preservation of both the building and its furnishings. Further evaluation will be necessary when the recommendations are developed to a level of design detail (advance planning: preliminary design/construction documents) specific enough to definitively identify specific building fabric impacts.

The recommended actions will have no adverse effect -- actions for preservation or repair of building materials which are suffering from the processes of deterioration, such as weathering of exterior wood elements. Action is necessary to halt deterioration. Some replacement is necessary of materials which cannot be repaired or preserved, such as broken or missing roofing tile to stop intrusion of water into the structure which causes deterioration of other materials.

Overall, the intent is to produce beneficial actions for long term preservation of the resource. Preservation is not achieved by no action, which clearly would be an adverse effect. The reader is referred to the Assessment of Effect section of this report for evaluation of the recommended treatments.

ASSOCIATED CONSIDERATIONS

PROJECT PHASING

As noted above, treatments must be implemented within an interrelated treatment strategy which will have the flexibility for annual adjustment because of funding and other factors that will vary from year to year. Annual work programs will need to be prepared in order to respond to such variables.

PRIVATE SECTOR AGREEMENTS

A new policy on tour group size has been instituted based on the structural analysis of the bridge which will slightly reduce the tour group size. This will not only reduce stress on the bridge but will enable the interpreters to have more control (artifact and furnishings protection and better presentation).

Possible future agreements with the cooperating association have been under discussion regarding interpretation. Concession agreements affect uses and operations in other structures (Motel/Garage), but not in the Main House and Annex.

RECOMMENDATIONS FOR DOCUMENTATION

The HSR is an instrument of documentation. No destructive investigations have been undertaken as yet. If destructive investigations are necessary in later phases of the preservation program undertakings samples of removed materials shall be accessioned into the district archival collections.

See other chapters for proposed documentation (color, paint, hardware finishes, and artifact environment studies).

OPERATIONS CONSIDERATIONS

Execution of some treatments recommended in this report will require developing a coordinated action plan involving all of the functional activities at Scotty's Castle, especially maintenance, curatorial and interpretation. The influence on operations will vary considerably. Much of the exterior work will not have any greater affect on curatorial or interpretive operations than similar work conducted in recent years. In contrast, installation of climate control systems (assuming implementation) will probably have the greatest effect on operations.

Other actions and developments may need to be implemented before the climate control system is installed. On a room by room, or building section basis, furnishings should be transferred to temporary protective storage. In some cases, historic items presently stored in closets which would be utilized for climate control equipment will need to be transferred to permanent museum collection storage. Since there is very little remaining space available for this, a new curatorial storage facility (which is proposed in the General Management Plan) may be necessary before climate control systems installation is practical. Other considerations are location of temporary furnishings storage, climate control for such storage, modifications of visitor tours and staffing. During various phases of building treatment work, adequate funding will be needed

for personnel and supplies for packing, moving, temporary storage, unpacking and reinstallation of historic furnishings and objects.

To maintain the necessary control over the quality of restoration work, it is strongly recommended that the present preservation staffing approach be continued as well as strengthened or expanded as the requirements of the work dictate. It is felt that the park based preservation expertise is the best way to minimize the effects of climate control equipment installation.

Park housing is not available for contractor's personnel. Because of travel distances, outside construction contracting is extremely expensive or difficult to obtain. At the same time there is a shortage of housing for park personnel. Therefore, housing is a factor relating to the size of the preservation staff needed at any one time to implement the elements of the preservation plan.

COMPLIANCE

An archeological survey of the historic district was conducted in April 1990. Refer to "Appendix A, Archeology" for findings and recommendations.

This Historic Structure Report for the Main House and Annex has been developed under the standards set forth in Cultural Resource Management Guidelines, NPS-28. Assessment of the effects of the recommended treatments is included in this report. In accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and the Programmatic Agreement for National Park Service Projects, the State Historic Preservation Officer and the Advisory Council on Historic Preservation have been consulted.

As a result of the consultation with the State Historic Preservation Officer and the Advisory Council, a determination of no adverse effect has been recorded for the treatment concepts recommended. By memoranda of concurrence between the National Park Service Western Regional Office, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, it has been agreed that individual compliance actions for specific phases of the preservation effort will be undertaken, especially for the implementation of the climate control system.¹ All treatment actions are to be preceded by the appropriate compliance procedures prior to execution.

BASIC DATA

The Death Valley Ranch archive contains an extensive collection of historic documents detailing the history and construction of the complex, including architectural drawings, material invoices and letters. This collection is so extensive that it will require many years for researchers to transcribe the information into useable form.

1. Letter, Regional Director, Western Region, National Park Service to State Historic Preservation Officer, October 24, 1990, and Chief, Western Office of Review and Compliance, Advisory Council on Historic Preservation, November 26, 1990. See the Appendix B, Letter Requesting Review and Comment from the Advisory Council on Historic Preservation.

Basic information may be found in the List of Classified Structures entries and in the National Register of Historic Places nomination form, both previously cited.

There are also a number of National Park Service documents and reports, which are on file at the park as well as other service depositories. Refer to the Annotated Bibliography in the History section of this Historic Structure Report for descriptions and listings of both historic and recent documents.

The most recent existing conditions drawings of Death Valley Ranch are Historic American Buildings Survey (HABS) drawings series CA-2257, dated 1989.

TREATMENT PRIORITIES AND ESTIMATED COSTS

ESTIMATED CONSTRUCTION COSTS, 1991

<u>Priority</u>	<u>Treatments</u>	<u>Estimated Costs</u>
1	Environmental Control	\$ 339,859
	Electrical Power Upgrade	11,725
	Fire and Intrusion Detection Upgrade	41,000
2	Annex Second Floor Deck	76,235
3	Exterior Wood; Fountains	344,230
4	Roofs	133,190
5	Exterior Stucco	131,620
6	Exterior Tile	82,870
7	Metals and Glass	213,130
8	Interior Wood and Plaster	550,220
9	Interior Tile	96,880
10	Arbor	40,000
11	Drainage	90,917
12	Concrete and Pest Control	47,500
13	Brick	25,000
14	Structural	155,716
	Emergency Power, Plumbing	85,500
	Estimated Total	<u>\$ 2,465,592</u>

ESTIMATED ANALYSIS AND DESIGN COSTS

Climate Control System Design	\$ 55,000
Fire Suppression Analysis	\$ 35,000
Furnishings and Materials Conservation Assessment	\$ 45,000
Color and Finishes Analysis	\$ 116,000

1991 class "C" estimates by Denver Service Center. To update to future years add annual inflation factors.

APPENDIXES

RESOURCE ADMINISTRATION

APPENDIX A, ARCHEOLOGY



United States Department of the Interior .

NATIONAL PARK SERVICE
WESTERN ARCHEOLOGICAL AND CONSERVATION CENTER
P.O. BOX 41058
TUCSON, ARIZONA 85717

IN REPLY REFER TO:

H2215 (DEVA)

May 7, 1990

Memorandum

To: Chief, Division of Archeology

From: Archeologist, Division of Archeology

Subject: Trip report, Death Valley. Archeological survey of Scottys Castle, and other matters

During the period April 10-13, 1990, I traveled to Death Valley and surveyed the grounds of Scottys Castle. I also monitored the condition of other properties at the park. I was accompanied by Jan Lawson, Death Valley Cultural Resource Management Specialist. My findings are given below:

1. Survey of Scottys Castle (WACC project number DEVA 1990 B). Denver Service Center is preparing a Historic Structures Report for the Castle. It is expected that the Report will recommend rerouting or new installation of utility lines, as well as grading to improve drainage. An archeological survey was needed to prepare for compliance documentation. The survey boundaries encompassed the core developed zone, and included all historic properties, housing, parking lots, and the maintenance yard (see enclosed maps). In all, roughly 15 acres were surveyed. Survey was accomplished by walking parallel transects 10-15 meters apart on center. The majority of the ground surface has been graded, paved, or otherwise disturbed. In undisturbed ground, visibility ranged from 70-100%, depending on vegetation density. Twelve person-hours were expended in survey.

No prehistoric archeological resources were found. There were also no indications of buried or surface historic archeological deposits such as trash pits or privies. There is, however, the remains of a burned hay storage platform in the east end of the study area, north of the overflow parking lots (see maps). Within an area measuring 20 X 30 feet are eight vertical concrete fence posts, a few burned railroad ties, a pile of cut lengths of hay wire, and two coils of barbed wire. I don't know if the platform dates from the older Johnson occupation of the Castle, or from some later period of use. This issue should be addressed by Castle staff or the regional historian. If the feature is found to be significant, it could be added to the existing National Register nomination form as a contributing element to the historic district. In the meantime, I suggest we leave the feature as it is, and avoid impact to it. It is not likely that rehabilitation of the Castle will pose any threat to the hay platform.

I understand that compliance needs of the historic structures will be met through the use of XXX forms. As is our policy, we will delay issuance of the archeological clearance until final plans for rehabilitation have been made. Providing that development or rehabilitation is confined to the survey area marked on the maps, a clearance can be issued by this office without further field work.

2. Gravel separator rehabilitation. George Voyta asked me to take a look at the 1920s gravel separator just west of the gatehouse. The facility is on the List of Classified Structures and is part of the historic district. I had already gone over this ground in 1982 in conjunction with a leach field survey. There are no prehistoric cultural resources in the vicinity of the feature. At present, plans for rehabilitation of the facility have not solidified. Therefore, there is not much point in worrying about compliance documentation at this point. After plans are made, updating the existing XXX form may suffice, but I will also provide an archeological clearance if that seems an appropriate course of action.

3. Castle Spring prescribed burn. The park is considering burning off vegetation in the part of Grapevine Wash that runs from the old ranch fence on the east down to the levee. The area involved measures about 800 X 150 feet. It has been burnt over before. Jan and I conducted a reconnaissance and determined that the area is entirely within the active portion of the wash bottom and has been subjected to intensive flooding. There is little likelihood that people occupied the area in the past or, if they did, that anything will have survived the flooding. Therefore, there is no potential for impact from the burning on cultural resources. Whether to issue a clearance is a judgement call since the potential for impact is considered to be nil. If the park decides to ask for a clearance in the interests of complete documentation, we will, of course, issue one. As always, we will need to see the burn plan first.

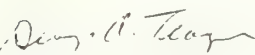
4. Mesquite Spring. We monitored the condition of the large site in the dunes at the north edge of the campground. Through quick action on the part of park staff a couple of years ago, the campsites adjacent to the archeological site were closed off when it became apparent that foot traffic was contributing to erosion of the dune and consequent exposure of archeological materials. The erosion seems indeed to have slowed, but continues nonetheless through natural agencies. We really ought to do something about this, but I'm not sure what. Some form of stabilization seems the obvious choice. Perhaps rip-rap, backfill, sand nets, or plantings could be employed, either singly or together in a way that would not detract from the natural scene. From what little I know about these techniques, I am not encouraged; still, it wouldn't hurt to experiment. I called Jim Rancier, the stabilization man at SOAR, to see if he had any experience in these matters, but he was out of the office. Roger Kelly was involved in dune stabilization on San Miguel Island some years ago, so he may have information on the subject. Maybe we ought to send somebody to one of those BLM/COE short courses on non-structural site stabilization.

5. Gas line site. We checked up on the site that lies along the gas line corridor just south of Furnace Creek Ranch. The site contains a rock structure footing, historic period trash, a possible cremation, and two possible graves. The site is in good shape, and hasn't been bothered since Ross Hopkins and I found it a couple of years ago. Still, we ought to get a decent site record made.

6. Texas Spring Trail. Jan and I looked for bone, which had been reported by Shirley Harding to be exposed along the trail. We found two small exposures on the banks of the wash that runs along side the trail, but couldn't make much of them. The bone was sparse and badly deteriorated. We did identify one tooth as being from a large quadruped, but were both too rusty on osteology to be able to say more. Maybe one of the naturalists at the park could lend a hand.

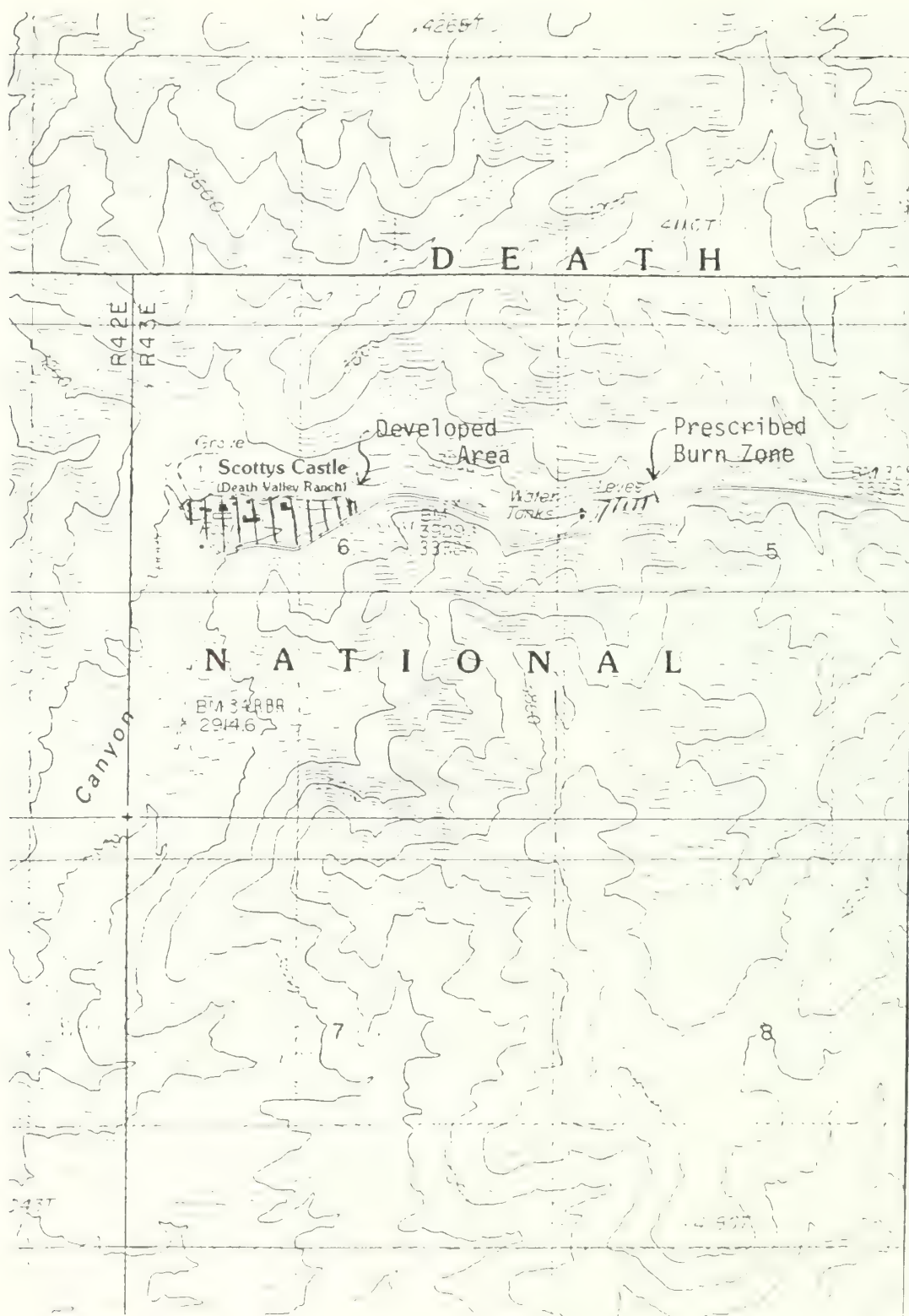
7. Skidoo Town Site. We went to check the condition of the Skidoo town site. We found evidence of considerable bottle digging in the trash dump just north of the town site. There are two holes about five feet deep and measuring 8 X 12 feet at the surface. There are at least 20 other holes of lesser dimensions (the two large holes, incidently, may have begun as cellars, which were later used as trash pits. It would be hard to tell without poking around). The holes reveal substantial deposits of buried, stratified trash dating from the period ca. 1900-1920. These deposits are archeologically significant, in my opinion. Judging from the amount of slumping, the holes were not dug recently. The damage may very well have been done before the Service attained jurisdiction in the area in the 1980s.

In any case, I recommend frequent law enforcement patrols of the town site. I do realize that the district rangers already have a big load to carry, but there isn't much that will substitute for a uniformed presence. In addition, we need to collect precise data on the current extent of impact. This would provide baseline information to assist rangers in monitoring for further impact, and to be used in evidence if an ARPA case can be brought against future or past bottle hunters. We need to map the entire 100 X 300 yard townsite-dumpsite, and to measure, photograph, and otherwise record all archeological features and bottle-hunter holes. I can provide a budget and scope of work upon request.


George A. Teague

enclosures (2 maps)

cc: w/c enc.
Superintendent, Death Valley National Monument
WR-RH Roger Kelly, Regional Archeologist
DSC-TWE Robert Carper, Architect
DEVA-Jan Lawson, Cultural Resource Management Specialist
DEVA-George Voyta



DEVA 1990 B. Area location map, showing Scottys Castle developed area and prescribed burn zone. Scale 1:24000. North to top. Map source: Scottys Castle Calif.-Nev. 7.5' USGS quadrangle, 1988 (provisional).



DEVA 1990 B. Detail map, Scottys Castle developed area, showing area surveyed archeologically.
Map source: Denver Service Center, NPS.

APPENDIX B, LETTER REQUESTING REVIEW AND COMMENT FROM THE ADVISORY COUNCIL ON HISTORIC PRESERVATION



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE

WESTERN REGION

450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

DEC 5 1990

H4217(WR-RH)

November 26, 1990

Ms. Claudia Nissley
Chief, Western Office of Review and Compliance
Advisory Council on Historic Preservation
730 Simms, Room 450
Golden, Colorado 80401

Reference: NPS881230A

Dear Ms. Nissley:

Enclosed is a draft Historic Structures Report for Scotty's Castle, Main House and Annex, a property on the National Register. We request your review and comment in accordance with Section 106 of the National Historic Preservation Act of 1966 and 36 CFR 800, the Procedures of the Advisory Council on Historic Preservation.

The Historic Structure Report will provide the basic information and direction in preservation of the Castle and includes research, analysis and recommendations. We feel that the recommendations or proposed undertakings are consistent with the Secretary of the Interior's Standards and Guidelines.

The most difficult part of the study involves the heating, cooling, ventilating and humidification systems and likely additional clarification will be provided in the final report. We call your attention to that section. Basically, three alternatives exist:

1. No action, which is not satisfactory due to the existing and increasing damage to interior wooden surfaces of the structure and museum objects. Basically, the humidity is too low, causing wood to dry and crack.
2. Interim treatment level, which is proposed to be accomplished first. This offers high potential to correct the problem with the least loss of historic fabric. The Castle has in place extensive monitoring and documentation of existing conditions which is reflected in the entire report and extensive monitoring will continue.

DEC 19 1990
ADVISORY COUNCIL
ON HISTORIC PRESERVATION
for Claudia Nissley
CLAUDIA NISSLEY
Director, Western Office
KLP

3. Comprehensive environmental control system, which has undesirable aspects in the loss of historic fabric in installation, construction costs, operational costs and concerns about maintenance in the isolated area. This alternative would be considered only after the interim treatment aspects were accomplished. A comprehensive system, if indicated, would be the subject of a separate compliance action under 36 CFR.

We have considered the effects of the proposed undertaking and feel that an effect will occur. We also feel that the effect would not be adverse. The California State Historic Preservation Officer has reviewed this undertaking and concurs with our determination of no adverse effect; a copy of her correspondence to us is enclosed.

We would appreciate your review and comment. Should any questions arise in the review please contact Tom Mulhern of this office at (415) 556-8376.

Sincerely,



Stanley T. Albright
Regional Director, Western Region

Enclosures

cc:
Superintendent, Death Valley, w/o encs.
DSC-TWE: Bob Carper, w/o encs.



Photo by Jack E. Boucher, Historic American Building Survey,
HABS No. CA-2257 AA-7, ca. 1987-89.

HISTORY

A HISTORY OF DEATH VALLEY RANCH

Richard A. Bernstein, Historic American Buildings Survey
Holly K. Chamberlain, Historic American Buildings Survey
Harlan D. Unrau, Historian
History

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PREFACE

The historical narrative for this report consists of elements produced by the Historic American Buildings Survey (HABS) and the National Park Service (NPS). In 1987 Richard A. Bernstein prepared a draft historical study of Death Valley Ranch under the auspices of HABS. Holly K. Chamberlain, a HABS employee, edited and finalized the Bernstein draft. This HABS study has been edited and rewritten by Harlan D. Unrau, a historian with the Denver Service Center of the National Park Service, to place the narrative in a National Park Service format. Additional data, particularly relating to the Gospel Foundation and National Park Service periods, was provided by James O. Barr, curator at Scotty's Castle, for incorporation in the narrative. Unrau also compiled a chronology and annotated bibliography for the present report.

Harlan D. Unrau
April 1990

INTRODUCTION

Everybody wonders about the Castle – why it is and what it is. That’s what we wonder too. Scotty says it never had any beginning and it never will have an ending. And that’s about true. It certainly is far from finished and it never really started. You see, we built a garage and storeroom first, and two or three bedrooms overhead. We lived in this for a while, and it was ugly. Then we began decorating and glorifying it til it turned into a castle with an organ and a bell tower and chimes. Anyway, it makes a fine lodge when we come in off the desert, hot and dusty. It’s not nearly finished and maybe never will be. We don’t know. We build as fancy leads.¹

So wrote Bessie Johnson, the wife of Albert Mussey Johnson, a Chicago millionaire. What had started as a business expedition to inspect some mining claims became a regular seasonal vacation and ultimately a ten-year building campaign. The subtle allures of the desert combined with the captivating companionship of the likable Walter Scott, known to the public as Death Valley Scotty, to persuade Albert to forsake the luxuries of a mansion on the shores of Lake Michigan.

Between 1906 and 1922 Johnson visited the area about a half dozen times. Scott always met Johnson upon his arrival and acted as his guide. The two men would camp in canvas tents and tour the barren desert wilderness of Death Valley by horseback. Albert’s visits were often as long as a month. At first his interests were primarily focused on the many mining claims he had either invested in or had simply heard about.

At some point his interest in the area became more personal. His business life and the hard Chicago winters were exhausting, and he often felt a need for a complete rest and change.² A stay in the desert always proved beneficial for his health and relieved many of his various ailments.

In 1915 Albert began acquiring land. Within two years he had dubbed his property the "Death Valley Ranch."³ His holdings, which eventually totalled more than 1,500 acres, were split into two separate parcels about eight miles apart, and therefore referred to as the Upper and Lower Grapevine ranches.

In 1922 Albert began building something of his own. This first phase of construction lasted for four years and resulted in four rudimentary structures: a large main house, garage/storeroom/workshop, a cook house, and stables. All four were wood-frame structures and all but the stables, which was sheathed with corrugated sheet metal, were stuccoed. In fact, they were all very plain and rather severe, but more substantial than the tents and shacks Johnson and Scott had been using as shelter until then.

1. Bessie Johnson, *Death Valley Scotty by Mabel* (Death Valley, Castle Publishing Company, 1941), p. 156. This publication was written by Bessie Johnson in 1932 but was not published until 1941. She used the pen-name Mabel because that was Scotty’s nickname for her.

2. Albert M. Johnson to Cliffe Merriam [his sister], April 13, 1917, Manuscript 2, Box 4. All primary source materials used for this study may be found in the library and archives at Scotty’s Castle.

3. The earliest known reference to the usage of the name Death Valley Ranch was found in a letter from Albert M. Johnson to Cliffe Merriam on April 25, 1917. Manuscript 2, Box 4.

In June 1926 a professional designer was contracted to remodel and lavishly appoint these early buildings utilizing a Spanish Mediterranean motif and to design several more. Plans for increasingly luxurious surroundings expanded for the next six years and eventually included a large swimming pool with fountains and arcades, chimes tower, entrance gates, and formal landscaping replete with rock-lined watercourses and cactus gardens. Self-sufficiency was an important factor to the complex and can be seen in the complete water and power systems.

Due to a variety of reasons, primarily the uncertain ownership of the land and Johnson's financial reverses during the Depression, in August 1931 construction was suddenly halted and – although hopes lingered on – was never resumed. This left incomplete several projects that had only just begun.

CHRONOLOGY

LAND ACQUISITION AND EARLY DEVELOPMENT

1880s

Land in Upper Grapevine Canyon, on which Scotty's Castle would be built, was originally patented by Jacob Steininger during the 1880s under the provisions of the Desert Land Act of 1871.

1906

Albert M. Johnson and Walter Scott (Death Valley Scotty) made their first journey to the Death Valley region to inspect Scotty's elusive mines.

1906-1922

Johnson and Scotty visited the Death Valley area about a half dozen times, the former relishing the climate, scenery, and isolation of the region as well as the companionship of the latter.

1915-1917

Johnson began acquiring old homesteads and mining claims in northern Death Valley, including the Steininger Ranch property which he dubbed the "Death Valley Ranch." His holdings, which eventually totaled more than 1,500 acres, were split into two separate parcels about eight miles apart – the Upper and Lower Grapevine ranches.

CONSTRUCTION PERIOD

1921

Johnson decided to make improvements and construct more civilized accommodations on the Death Valley Ranch.

1922

Johnson began developing plans for the ranch and hired Frederick William Kropf as construction superintendent to oversee the improvements.

1922-1924

Kropf supervised all facets of construction of the first three structures – a garage, two-story main house, and cook house – before being dismissed in July 1924.

1924-1925

Construction of three secondary structures – the stables, chicken coop, and workshop/shed – was commenced using plans developed by Johnson.

1925

Matt Roy Thompson was hired as general superintendent for construction in October.

1925-1926

Under the direction of Thompson the three secondary structures were completed, and a one-story building, originally known as the "Cellar" but later referred to as the "Commissary," was erected parallel and to the north of the main building.

1926-1931

In June 1926 Charles Alexander MacNeilledge was hired to direct the overall planning and design of the Death Valley Ranch complex in a rather unique Spanish hacienda style variously referred to as Spanish Colonial Revival, Spanish Mediterranean, or Spanish Provincial. Between February and August 1931, when construction operations ceased, Martin D. de Dubovay was named to replace MacNeilledge. The position of building superintendent was established during the fall of 1926 and was filled by at least four men between 1926-31: F.X.A. Kreil, H. Brewster Brown, Chris J. Johnson, and W.D. McLean.

1929

Dewey R. Kruckeberg was hired as a landscape architect to supervise and direct the landscape design of the ranch.

PHYSICAL HISTORY OF STRUCTURES IN CASTLE COMPLEX

The physical history of the main house/annex may be seen in appendix D.

The physical history of other structures in the castle complex may be seen in appendix E.

LANDOWNERSHIP ISSUES

1930

On July 25 President Herbert C. Hoover signed Executive Order 5408 withdrawing more than 2,000,000 acres of land from the public domain, pending the outcome of further studies leading toward inclusion of Death Valley in the National Park System. In December Johnson was informed that previous land surveys of the 1880s, upon which his land acquisition endeavors had been based, might be incorrect. Subsequent surveys showed that the land he actually owned was one mile north and one mile west of the property on which he was constructing the castle complex.

1931

In August Johnson halted construction operations on the castle complex until his landownership problems could be fully resolved.

1933

On February 11 Death Valley National Monument was proclaimed by President Hoover. The monument included Johnson's lands in Grapevine Canyon.

1935

On August 22 President Franklin D. Roosevelt signed into law H.R. 2476 permitting Johnson to purchase his lands in Grapevine Canyon from the government at a cost of \$1.25 per acre.

1937

On November 17 a patent was issued to Johnson for 1,529.83 acres in Grapevine Canyon, thus restoring to him full ownership of the lands that he had originally thought he had acquired. By this time, however, he had lost much of his fortune and could not afford to resume construction.

CASTLE COMPLEX, 1930-1947

1926-1930

In 1930 Herman William Eichbaum, who had opened a 38-mile scenic toll road over Towne Pass in the Panamint Range bordering the western approach to Death Valley in May 1926 and had established the Stove Pipe Wells Hotel in November 1927, completed the first improved automobile road north through the valley from his hotel to the Grapevine Canyon area. Earlier in February 1927 the U.S. Borax Company had opened the Furnace Creek Inn some 50 miles south of Grapevine Canyon. The new roads and resort developments encouraged increasing numbers of tourists to visit Death Valley.

1930-1931

Increasing tourism to Death Valley led to growing interest in the developments underway in Grapevine Canyon. By April 1930 it was reported that a daily average of 40 to 80 visitors were arriving at the castle complex, and in February 1931 it was noted that holiday weekend visitation was up to 100 visitors per day.

Construction was still underway, and the visitors were generally viewed as a nuisance. The tourists were sometimes given impromptu tours by Scotty, but no meals were provided except on rare occasions when Scotty issued special invitations.

1933

As a result of their deteriorating finances the Johnsons moved from Chicago to Hollywood, California. Thereafter, they visited the castle generally on a monthly basis, staying for several days during each visit.

1934

During the early 1930s Johnson realized the economic potential of the growing number of visitors to Grapevine Canyon, especially in view of the decline in his personal financial resources. By 1934 tours of the main house and annex were conducted on an informal basis.

Johnson also envisioned potential financial value from the sale of postcards and hired Burton Frasher, a professional photographer, to take large format photographs of the castle complex buildings, interiors, and grounds. Frasher specialized in publishing postcards and often stayed at the ranch, taking photographs which he used to produce thousands of postcards for sale at the ranch.

1936-1937

By 1936 several young men and women had been hired and trained as tour guides and security guards for the castle, and an admission price of \$1.00 per person was instituted. Bessie Johnson, more so than her husband, administered the tour services and was known to conduct a few herself. During the winter of 1936-37 as many as 130 tourists took the one hour tour per day.

1941

In October 1941 guidebooks for the tour of the main house and annex were placed on sale as souvenirs. The guidebooks had been prepared by Bessie Johnson as a training manual for the guides and a memento for the public. In 1941 Johnson had 10,000 of the guidebooks privately published under the business name of the Castle Publishing Company.

1942-1945

Gasoline and tire rationing during World War II severely limited tourism and visitation to the castle complex. The decline in visitation resulted in a loss of income from the castle which earlier had amounted to as much as \$5,000 per month. Thus, it became more difficult for Johnson to meet the costs of operating and maintaining the castle.

1943

On April 22, 1943, Bessie Johnson died as the result of an automobile accident as she and Albert were traveling over Towne Pass, some 40 miles south of Grapevine Canyon. Albert was driving and lost control of the car. Bessie was thrown from the vehicle and died instantly. His sorrow over losing his wife of 47 years, together with his own deteriorating health, made it increasingly difficult for Albert to visit and properly maintain his Death Valley property.

CASTLE COMPLEX UNDER ADMINISTRATION OF THE GOSPEL FOUNDATION**1946**

Johnson established the Gospel Foundation, a socially oriented charitable organization, to manage his estate. Mary Liddecoat, a long-time family friend, was named president, and Walter Webb, a long-time business associate, became vice president.

1947

On May 19 Johnson inserted a provision in his will transferring all his landholdings to the Gospel Foundation upon his death. These included his property in Grapevine Canyon, the Shadelands Ranch near Walnut Creek, California, and the Johnson home in Hollywood, which became the office and headquarters of the foundation.

1948

Following the death of Johnson on January 7, the Gospel Foundation announced that it would continue to operate the castle complex as a "museum-hotel," offering regularly scheduled guided tours as well as nightly accommodations for 15-20 guests.

CASTLE COMPLEX UNDER ADMINISTRATION OF THE NATIONAL PARK SERVICE**1970**

In July the National Park Service purchased the Upper Grapevine and Lower Grapevine ranches, including the castle complex, for \$850,000, using funds provided by the Land and Water Conservation Act of 1965. The funds could not be used to purchase the castle furnishings. Thus, the Gospel Foundation donated the furnishings.

1973

Between 1970 and 1973 tours, routine cleaning, fire protection, and security at the castle complex were administered by National Parks Concessions, Inc. In 1973 the National Park Service assumed full responsibility for the maintenance and operation of the castle complex.

LOCATION

The choice of such a barren and isolated location, more than any other reason, makes Death Valley Ranch unique. Obviously, the Chicago winters were bitterly cold and the soothing heat and constant sunshine of Death Valley must have proved refreshing. Several personal accounts attest to how Johnson, a man who had been seriously injured in a train wreck, displayed a renewed vigor most thought impossible for a man in his condition, for here he roped and rode horses and played the role of "gentleman rancher" to the hilt.

That alone does not fully explain what was, to say the least, such an eccentric decision. Most published accounts center on Johnson's friendship and attachment to Walter Scott, more commonly known as Death Valley Scotty, as the central factor in his decision to locate here. No doubt that played an important part, for it was Scott who introduced Johnson to the area. Johnson had been one of several investors in a series of phony mining propositions Scott, a huckster and charlatan by trade, was habitually concocting. In 1906 Johnson made his first trip to Death Valley in order to inspect the mines Scott had convinced him existed. The state of Nevada and the entire region were then undergoing their last great mining boom because of the silver strikes in the Goldfield and Tonopah areas, neither of which were far from Death Valley. The two men traveled extensively together by mule and horseback investigating mines throughout the region, and it was not long after his first visit that Johnson realized the truth about Scott.

But even after Johnson realized that Scott had lied and cheated, he continued to befriend him. Perhaps, Johnson envisioned Scott as one of the last of the romantic figures engendered by the Wild West, or maybe Johnson was completely enraptured with the stories and tall tales Scott was so expert at telling. Despite Scott's rather scurrilous reputation, Johnson felt that he "was absolutely reliable and I don't know of any man in the world I would rather go on a camping trip with than Scott."⁴ Although Scott's involvement in all phases of construction was minimal, he frequently visited the ranch amid his many travels.

To say that the two men were opposites is an understatement. Johnson had been born into a wealthy family in Ohio. He was raised to be devoutly religious and never swore, smoked, or drank liquor. After graduating from Cornell University with a degree in civil engineering he married Bessilyn Morris Penniman and went on to make his own fortune in the corporate world of finance and big business. In 1899 Johnson and his father were involved in a train accident. Johnson's father was killed instantly and Albert's back was broken. He was immobilized and bedridden for eighteen months. Eventually he recovered, but was left with permanent chronic back problems.

Scott was born and raised on a working Kentucky horse farm. At the early age of eleven, Scott ran away from home to join his two brothers, employed as ranch hands in Humboldt Wells, Nevada. After working as a water boy for a survey team and running mules for the Harmony Borax Mines in Death Valley, Scotty worked for twelve years as a rough rider in the Buffalo Bill Wild West Show. He eventually moved back to Death Valley, established a camp near Grapevine Canyon, his favorite part of the valley, and adopted it as his home. Whatever the basis for their relationship, the two men continued to hike and camp together and Johnson could always count on Scott to meet him with horse and pack, ready to go.

4. Dorothy Shally and William Bolton, *Scotty's Castle* (Yosemite, California, Flying Spur Press, 1973), p. 9.

Besides their abiding friendship, other factors played a role in Johnson's decision to build a "Castle" in a countryside that most would have considered basically uninhabitable. For Johnson and his wife the isolation the land afforded was an asset. Albert knew that water was the most precious of all commodities in the desert and in his own words it alone "put a place on the map."⁵ After taking Bessie into the desert for her first time she also realized the value it had:

Water! I had never realized its importance before. You must travel the Wilderness to know its value. The Desert can never be largely populated just for the want of water. This is the reason we will never have near neighbors at the castle.⁶

The protection afforded from such an unpopulated land was something Johnson and his wife grew to appreciate and prize. Bessie observed:

We had traveled along through the sage, for three hours and had seen no one. Even to [this] day we often travel, on good roads, a hundred and fifty miles and never see a soul or pass a car. This is one of the charms of the Desert, after fighting your way through city traffic.

The peace of it is such a joy after the turmoil of life out side. The mountains are fortresses of protection.⁷

Fully cognizant of the essential role water played, Johnson purchased an already somewhat developed and particularly well-watered parcel of land – the Steininger Ranch. The Steininger property, which had been patented originally by Jacob Steininger during the 1880s under the provisions of the Desert Land Act of 1871, was situated in Grapevine Canyon and included a vineyard, some fig and fruit trees, and a few wooden shacks made of railroad ties. The shacks served as shelter for Johnson and Scott for the first few years before any construction was initiated. The ranch's greatest asset, however, was its abundant year-round source of water. The natural spring had a flow of 300 gallons per minute and supported the lush growth of wild grapevines that gave the canyon and the spring their names. This amount of water could more than adequately provide for their personal needs and would eventually be employed to run construction machinery and electrical generators when development intensified.

In addition the location was situated at an elevation of some three thousand feet. At that altitude it would escape the scorching temperatures of the desert floor and the sub-freezing temperatures of the high Nevada basin. This too gave the Johnsons a sense of protection from the elements. Bessie noted:

The Castle is three thousand feet high and is nestled away in a small protected canyon. Storms may be raging all around, but there's 'Peace in the Nest' and we are warm and safe and cozy, as the country round about is gripped in the arms of a raging blizzard and the mountains blanketed in snow.⁸

5. Johnson, *Death Valley Scotty*, p. 1.

6. *Ibid.*, p. 1

7. *Ibid.*, pp. 1-2.

8. *Ibid.*, p. 2.

Until 1921 Johnson had made his month-long trips to the desert a regular spring pilgrimage. He looked forward with anticipation to the chance to leave behind the worries and demands of high finance, but generally found it hard to get away.⁹

The year 1921 proved one of mixed blessings financially. At the same time the National Life Insurance Company, of which Johnson was president, had its best year ever, another company of which he was also president, the North American Cold Storage, lost over \$150,000. The loss of such a sum left Johnson depressed and resulted in his loss of confidence. While he was in this frame of mind it was harder to make split-second business decisions required of a man in his position.¹⁰

To relieve his depression, he took some time off to travel. After a one-week sojourn up north in September 1921, Johnson wrote to his sister Cliffe, describing how he felt renewed and what he hoped for the future:

The little week's trip I had away showed me how tired I was and how much I needed a change and a rest. It is a long pull and a steady strain, with responsibility and detail every day that wears you out; but things are in pretty good shape now and I am going to try to be away a little more this coming year.¹¹

Several days later Johnson informed his sister that he was going on a month-long trip with his final stop to be Goldfield, Nevada, sixty miles away, but still the closest town of any size to his property. He observed:

This is hardly a pleasure trip but more of a business trip, as there are a number of things I want to look over and we are going to make some changes on the ranch.

The letter does not say who the "we" refers to or what kind of changes Johnson had in mind. Nonetheless, it was soon thereafter that Johnson hired a superintendent to live and work on his ranch and to start construction of several new buildings.

9. Albert M. Johnson to Cliffe Merriam, April 13, 17, 1917, Manuscript 2, Box 4.

10. *Ibid.*, February 15, July 5, 1921.

11. *Ibid.*, September 19, 1921, Manuscript 2, Box 5.

COMMENCEMENT OF CONSTRUCTION

In the fall of 1922, after a year of planning his "changes on the ranch," Johnson hired Frederick William Kropf to be his construction superintendent.¹² He had met Kropf while visiting Deep Springs College, a boy's preparatory school established in 1917 some 70 miles northwest of the ranch by his close friend and associate L.L. Nunn. Johnson was a frequent visitor to the school and often stopped there enroute to his own property. While there Johnson would regularly confer with Kropf about his plans for construction. Kropf was, at the time, occupied with the erection of the school's first structures. When construction at the school was completed, Johnson hired Kropf to oversee his building operations.

Kropf oversaw all facets of construction of the first three buildings: first a garage, then a large two-story main house, and lastly a cook house. The buildings had flat roofs and flat white stucco finishes and were severely rectangular. Of the three structures, only the framing plans for the garage and main house, as well as a plan for the main house, survive. None are signed, but Johnson probably designed all of them himself.¹³ Trained in school as an engineer, he openly professed his preference for right angles for they symbolized that the building "was on the square."¹⁴

The work proceeded slowly at first with only a few men employed.¹⁵ Within a year a crew of approximately thirty men lived and worked at the site. The majority of them were Shoshone or Paiute Indians native to the area. The remainder were whites, generally skilled in a particular trade, such as carpentry, masonry, or plastering, that Kropf had recruited in Los Angeles. The entire crew was divided into teams that were each assigned a different task. For instance, one team would do all the lathing and plastering and another would truck and wash all the sand and gravel. The Indian crew was always assigned the tasks involving manual labor, and skilled work was almost always performed by white workmen. There was at least one instance, however, that an Indian worked as a plasterer. There were perhaps other exceptions as well, but Kropf preferred not to hire Indians because he felt they drank too much and were unreliable.¹⁶

Kropf was also a firm believer in unions and maintained an eight-hour day and six-day week as the standard schedule.¹⁷ Because of the extreme summertime temperatures, construction was generally suspended during the hottest months.

12. Interview of Melba Kropf Ford by Steven Harrison, January 21, 1980, p. 20, and Interview of Milton Kropf by Steven Harrison, January 21, 1980, p. 20.

13. Architectural drawings catalogue nos. 21295, 21322, 21323, 21324, and 21325.

14. Hank Johnston, *Death Valley Scotty: The Fastest Con in the West* (Corona Del Mar, California, Trans-Anglo Books, 1974), p. 105.

15. U.S. Department of the Interior, National Park Service, *Scotty's Castle Cook House: Historic Structure Report*, by Susan Buchel, 1985, p. 5.

16. Milton Kropf Interview, pp. 2, 19-20, 23, and Melba Kropf Ford Interview, p. 20.

17. Milton Kropf Interview, pp. 22-23.

Almost all the building materials, such as lumber and cement, were shipped by train and delivered to Bonnie Claire, the end of the branch of the Tonopah and Tidewater Railroad about twenty miles northeast of the construction site. From there they were hauled over poor dirt roads by the ranch's own trucks to the ranch itself.

Most of the construction work was accomplished manually with hand tools. Scott's mules pulled a Fresno scraper for almost all the excavation and grading work necessary for the earliest structures. In at least one instance, Kropf piped water down from the springs farther up the canyon and prepared the site for the main house by hosing it flat.¹⁸ In order to plaster the upper part of the two-story main building, the men employed what they referred to as "outriggers." These were simply pieces of lumber secured by cleats that extended beyond the roof and were sufficiently sturdy to hold scaffolding.¹⁹

Once the main building was finished, the Johnsons took residence in the upstairs apartment. Johnson often visited the ranch without Bessie. Conditions were still primitive compared to what the Johnsons were accustomed to in Chicago and what Albert thought proper and fitting for his wife. Scott moved from his shack and occupied the room on the ground level just below the Johnsons' apartment. This freed the shack Scott used for the occupancy of other employees.

Whenever Johnson was at the ranch he became deeply interested and involved in every aspect of construction. He constantly gave Kropf verbal instructions, perhaps accounting for why so few original drawings for much of the work of this period can be found.

Scott's responsibilities relating to the construction were minimal. During the first year Scott cooked all the meals provided the white crew. Melba, Kropf's daughter, was hired in August 1923, when the number of employees was increasing, to replace Scott as cook. One of the rooms in the north end of the garage, the first building to be finished, was used as a kitchen. Melba lived in the storeroom next to the kitchen in the garage.²⁰

Kropf and his son Milton put in a concrete floor and shared one of the "tie shacks" left over from the Steininger Ranch. Milton, still a young boy, helped with filling out the payroll and the monthly progress reports sent to Johnson's personal secretary, Miss Devlin, in Chicago.

Johnson provided all the white men with housing that usually consisted of either canvas tents or crude temporary structures. Room and board were deducted from everyone's wages. The Indians provided their own housing that consisted of either tents or wickiups, and did not pay for room and board, although their wages were generally on a lower scale.

Johnson insisted that the two groups of men live separately in segregated camps. The Indian camp was usually farther up the canyon and beyond the limits of the property Johnson owned, where the white workmen generally resided. Johnson did not allow any alcoholic drinking and forbade visitation to the Indian camp by the white men. If caught the perpetrator was fired. It

18. Melba Kropf Ford Interview, p. 15.

19. Milton Kropf Interview, p. 15.

20. Melba Kropf Ford Interview, p. 26.

is not known for sure why he was so insistent upon the latter provision or which group he sought to protect.

While Bessie was at the ranch she held frequent religious services that all the white men were required to attend. The location of the services varied throughout the grounds. Although Albert was gaining a national reputation as a preacher, only Bessie would deliver the sermons at the ranch. Kropf, raised as a Mormon, once interrupted Bessie and said, "For a change we would like to hear some concepts from some other religion. We will hear from this fellow."²¹ It is not certain if this was the cause, but it was not long afterward that Kropf was dismissed. His services were terminated in July 1924. Melba had been fired because of a disagreement with Bessie three months earlier.²²

During the winter of 1924 Johnson attempted to find a replacement for Kropf and made efforts to locate Matt Roy Thompson.²³ Thompson had been a long-time friend of the Johnsons. He had first met Bessie while they were both students at Stanford University. Because of the losses his family incurred in the Panic of 1893, Thompson was forced to leave school. At approximately the same time, Bessie transferred to Cornell where she met and eventually married Albert. Thompson and the Johnsons stayed in touch infrequently over the years. When the Johnsons contacted Thompson he was employed by the Interstate Commerce Commission (ICC) as a land appraiser.

Thompson traveled to Chicago to discuss the ranch project. Johnson offered him the position, and then Thompson accompanied the Johnsons to Death Valley to see first hand what the project entailed. Thompson received a one-year leave of absence from his government position, and he accepted the position as general superintendent at the Death Valley Ranch. Thompson expected to resume his activities with the ICC after only a single year in Death Valley. As plans and his involvement grew, so too did his commitment to the project. He stayed in Johnson's employ for the next six years.

Thompson assumed his duties at the ranch in October 1925. The stables, chicken coop, and workshop/shed, all under construction when Thompson started work, were probably commenced after Kropf had left. This means that for approximately one year construction had continued without an on-site supervisor. By the time Thompson arrived, the stables required only a few finishing touches. Construction of the workshop/shed had started, but required considerable work, and was one of the first major projects Thompson oversaw. The chicken coop was just nearing completion when Thompson arrived at the site. All three of these buildings were designed by Johnson. The stables and the shed were designed in November 1923, within a week of each other, and are similar in many respects.

By 1924 a separate cook house was finished. This structure was devoted to preparing meals for the white crew. Besides a kitchen, it included a dining room for the men and a bedroom for the cook. Since the food preparation, cooking, and eating of meals now took place exclusively in the

21. Milton Kropf Interview, p. 27.

22. Melba Kropf Ford Interview, p. 14.

23. M. Roy Thompson, Jr., "Scotty's Castle Was Bessie's Baby" (n.p., n.d.), p. 5.

cook house, the storeroom and cook shack in the north end of the garage were no longer necessary. They were converted to be used as Thompson's office and private apartment.

The first project Thompson undertook from the beginning was a one-story structure parallel and to the north of the main building. In January 1926 Thompson went to Los Angeles to recruit additional workers for this building.²⁴ It was to be made entirely of concrete and would serve various purposes. Originally known as the "Cellar" it would later take the name of one of its major rooms and be called the "Commissary" or "Commissary Building." The commissary itself served as a storeroom for food stuffs and other general supplies. A large open-air room in the center of the structure sheltered a work area for construction machinery and later was also used as a garage for automobiles. The room to the west of that became the "Power Room" where a Pelton water wheel would drive a small electric generator.

In early 1926 a reporter visited the ranch. An article in the March 1926 issue of *Sunset* magazine described the buildings at the ranch:

Already there is a two-story building of concrete construction (the main house), with screened-in sleeping quarters, luxurious bath rooms and expansive dining quarters. There is a garage that houses three trucks and two passenger cars and has sufficient empty space to care for a fire department. There is another enormous building (stables) that shelters mules used in the development work. And Scotty is building a plant (the Commissary Building) to generate electricity by the use of power that comes from spring water flowing from higher ground.

This is only one of the many articles of the period that mentioned Scott as the main protagonist of the project. The activity at the ranch combined with its usual location caused word of it to spread. Ironically, the Johnsons chose this location in order to escape the crowds and pressures of the city. They certainly did not mean to attract the attention of the curious public. The lavishness that they sought in their new home was not meant to impress strangers or the public-at-large, but only meant to please themselves and to ingratiate those few individuals they invited there as guests.

Scott was a character who loved to be center stage. He practically thrived on it, while neither Albert nor Bessie cared for that kind of attention. In fact, Albert purposely tried to keep his name out of the newspapers and began to rely on Scott to handle all publicity.²⁵ Albert must have realized that he would need a front if he were to evade the public's growing scrutiny. When asked by a reporter what his relationship to Scott and the ranch was Johnson reportedly said, "I'm only his banker."²⁶ Although Scott had practically nothing to do with any part of the construction directly, Johnson continued to allow Scott to be the figurehead for the entire operation. Friends of the Johnsons and those who actually worked there knew the truth, but

24. M. Roy Thompson to Albert M. Johnson, January 21, 1926, Manuscript 7, Box 1.

25. Albert M. Johnson to M. Roy Thompson, February 9, 1927, Manuscript 5, Box 3. Johnson sent this letter to Thompson in reaction to an article he saw in a Goldfield newspaper. It was based on an interview Thompson had given while he was in Tonopah. The article mentioned Johnson by name as a Chicago millionaire and insurance magnate and that Johnson and not Scotty was responsible for all the construction in Grapevine Canyon.

26. Johnston, *Death Valley Scotty*, p. 101.

most of the public was kept unaware. The sham was so convincing that even today it is hard to separate fact from fiction.

EMPLOYMENT OF CHARLES ALEXANDER MACNEILLEDGE AS ARCHITECT

It was not long after construction began at the ranch that Johnson began thinking about hiring a professional architect to design something more splendid and appealing. The first architect he approached was Frank Lloyd Wright. Wright had recently established an architectural office in Hollywood and his recent commission for the Imperial Hotel in Japan had withstood an earthquake. Wright attributed the survival of the hotel to his use of cantilever construction. The favorable publicity Wright received was tremendous and might have been the reason Johnson was drawn to see him.

Besides the ranch, the two men discussed the possibility of designing a large office building on the property Johnson owned adjacent to Water-Tower Square in Chicago. Wright was paid a twenty thousand dollar retainer and together the two men traveled by car to Grapevine Canyon sometime during the winter of 1923. Afterwards, Wright prepared approximately twenty drawings for what he titled the "Dwelling of Albert Johnson."

The reasons Johnson decided not to use Wright's designs are unclear. Wright, in his autobiography, believed that Johnson was too conservative for something so daring and different. According to a second account, Johnson remarked, "Mr. Wright's plans were beautiful in their indigenous purity, but they were in keeping with one's idea of an adobe indian village – not a real hacienda, which we wanted – so we discarded them."²⁷

In November 1925 Thompson prepared a simple line drawing of his own for the remodeling of the main house. The basic element of the design was to add a series of round-arched porticoes to encircle the entire house and the building behind it, the commissary. A lake was to be built in front that would feature some stone work along the shore. Thompson later explained that he wanted to reproduce the effects of the campus at Stanford, his alma mater.²⁸

Johnson chose Charles Alexander MacNeilledge as the man to remodel his Death Valley Ranch. On June 4, 1926, the two men entered into a contract, the stipulations of which required that MacNeilledge be paid a \$1,000 flat fee in return for the

designing and preparation of sketches and detailed working drawing [sic], sufficiently detailed to enable my carpenters and other workmen on the job to erect buildings according to your sketches, and also including the purchasing and bills of material for the Redwood lumber, hardware, electric light fixtures, etc. required for my main house or residence with attached porches and pergolas, etc., located in Grapevine Canyon, Death Valley, Inyo County, California.²⁹

This quote seems to indicate that some of the basic design elements that make the ranch unique were already decided upon at this point, particularly the use of specific materials and the emphasis on metal hardware and custom-made lighting fixtures.

27. *Ibid.*, p. 104.

28. *Ibid.*, pp. 104-05.

29. Albert M. Johnson to Charles Alexander MacNeilledge, June 4, 1926, Manuscript 5, Box 1.

ARCHITECTURAL STYLE AND DESIGN

The style chosen for the Death Valley Ranch complex has been referred to in several ways. Some have called it Spanish Colonial Revival; others Spanish Mediterranean. Others have said the ranch was modeled after a Spanish village or hacienda, while others have preferred to cite its Spanish-Moorish influences. Bessie Johnson liked to call it "Spanish Provincial." Albert Johnson followed the lead established by the architect himself, who simply termed it "The Spanish Style."

Unfortunately, the ranch evades simple definition, but the design of the house and subsidiary buildings had for the most part a Spanish origin. The Spanish influence was being felt throughout the country. On one occasion Johnson had been greatly impressed by it near his home in Chicago:

I have been talking to Mr. MacArthur, who is our City Manager for Chicago, and who is building a house out west of Lake Forest in the Spanish Style.

He is using hollow tile walls with wooden trusses similar to the ones we are using. He bought his old timbers, picking them up around Chicago worm-eaten and full of nail holes, had them hewn and is putting them in place.

He was down in the City of Mexico and for some \$200.00 to \$300.00 bought a large amount of Spanish furniture.³⁰

There was a point when Johnson had tried to convince MacNeilledge to accompany him to Mexico in order to purchase some antiques at relatively inexpensive prices. Because of his incessant business obligations, Johnson never had sufficient time to make the journey. Having heard the suggestion, MacNeilledge continued to consider the idea a good one and made repeated attempts to have Johnson go with him. In August 1928, MacNeilledge was commissioned by Johnson to go to Spain and Italy instead. In his three months there, he bought numerous furniture and decorative pieces, most of which were used in furnishing the main house and annex.

Several glossy picture books of Spanish furniture and interiors were published in the 1920s, and Johnson purchased them for his library. Two of the books Johnson owned, Harold Eberlein's *Interiors, Fireplaces and Furniture of the Italian Renaissance* (New York, 1916) and Arthur Byne's *Spanish Interiors and Furniture* (New York, 1921-25), contained plates that focused primarily on interiors and their furnishings.³¹ That can also be said to be true for the buildings of Death Valley Ranch as a whole, most particularly the main house. The greatest skill MacNeilledge possessed was his flair for designing furniture and interior fixtures. He had probably never been formally trained and never registered as a licensed architect with the state of California.

Although not directly charged with any of the responsibilities of design, Thompson had considerable experience in this area. His two years in engineering schools combined with his experience in laying out subdivisions near Tacoma and Berkeley served to equip him with the

30. *Ibid.*, December 30, 1926, Manuscript 5, Box 1.

31. U.S. Department of the Interior, National Park Service, *Scotty's Castle Furnishings, Death Valley National Monument*, by Katherine B. Menz, 1979, p 13. (Draft)

skills necessary for certain project needs at the ranch. In November 1929 his abilities in this area were formally recognized. He was officially charged with designing all "necessary structures not of architectural importance, such as culverts, tunnels, manholes, subterranean buildings, etc."³²

MacNeilledge, experienced essentially as a furniture designer and interior decorator, probably possessed a greater sensitivity for the use of individual materials and their craftsmanship than he did with general engineering and architectural principles. This greater sensitivity for the use and handling of materials is visibly evident in the design and construction of the Death Valley Ranch complex.

The ranch has at least five particular design elements that stand out as being prominent. They are the use of wood, primarily redwood; the stucco finishes; the use of ceramics, particularly in the form of tile; the amount of hand-forged or wrought-iron hardware, especially the lighting fixtures; and the interior furnishings.

Most of the custom designs utilizing these materials were primarily accomplished by MacNeilledge, albeit with the help of the draftsmen he employed and the craftsmen he commissioned. There were times that MacNeilledge sub-contracted with outside individuals, but this did not occur often.³³

32. M. Roy Thompson to Albert M. Johnson, November 8, 1929, Manuscript 7, Box 9.

33. *Scotty's Castle Furnishings*, p. 15.

CONSTRUCTION MATERIALS

STUCCO

One of the first things to meet the visitor's eye on arrival at the ranch is the muddy brown and creamy beige two-tone exterior stucco finish. The underlying darker brown coat with its scratch marks is intermittently revealed.

This particular treatment was one of the first orders of business MacNeilledge set about formulating. Within a month of signing his first contract, MacNeilledge requested that Thompson send him fifty pounds of sand from the site "for testing to see if it's suitable for purposes in mind."³⁴ By the following October MacNeilledge was hoping soon to send Johnson an example of what he proposed for the house along with the instructions for its applications.³⁵ Towards the end of the month Johnson wrote a letter from the construction site:

We should have the plaster finish for the commissary rooms together with full details as to color and character and texture. The lack of this material is holding us back especially on the completion of the power room.³⁶

A few days later Macneilledge fulfilled his promise, stating:

The colors are to be used as follows: all exteriors of both buildings to have No. 18 finished as sample, which is a float finish with a top dash brushed down with a broom, then to have a brush coat of the light no. 48 which will have a weathered adobe effect.

As was the case in almost everything at the ranch, age was highly prized. Whether it was real or simulated did not matter. More important was how it appeared. In other words, the effect was more important than the reality. Included in the same correspondence were the instructions necessary for the preparation of various undercoats for different building surfaces, generally either concrete or hollow tile.

When two thirds of the main house was stuccoed, MacNeilledge visited the ranch and reported the following to Johnson:

I am pleased with the color and texture. It was quite a struggle to get the desired effect as it had never been done before, but I feel sure you will approve of it when you see the building.³⁷

By the following June, MacNeilledge had devised the basis for the interior finishes of the main house and annex. They were to be treated in a separate fashion. MacNeilledge conceived of four separate types of plaster finishes, each to be defined by its texture. He termed these Mexican, Latin, and Spanish. The fourth variety, named Travertine, was reserved for certain exterior areas

34. M. Roy Thompson to Charles Alexander MacNeilledge, July 29, 1926, Manuscript 7, Box 2.

35. Charles Alexander MacNeilledge to Albert M. Johnson, October 23, 1926, Manuscript 5, Box 1.

36. Albert M. Johnson to Charles Alexander MacNeilledge, October 26, 1926, Manuscript 7, Box 20.

37. Charles Alexander MacNeilledge to Albert M. Johnson, November 8, 1927, Manuscript 5, Box 1.

such as balconies. In some cases it was to be scored to simulate stone blocks. Each of these categories would have variations within them as to basic coloration. The color was determined by mixing different stuccos, and the texture was achieved in its application.³⁸

Certain difficulties arose, however, because of the many intricacies involved. The work suffered because of a constant turnover among the work crew. Having different plasterers, each with different methods, working on several buildings, and sometimes on the same building, resulted in some unintended but visible inconsistencies. Complications also arose from the fact that the ranch was purchasing stucco from at least three different suppliers. Matching the product of one distributor to another often took extra pains and effort.

WOOD

MacNeilledge liked redwood primarily for its color.³⁹ Although it is not the only type of wood used at the ranch, it does predominate since it is generously used in areas of high visibility. It is consistently utilized as an exterior building material in doors and doorways, window and door lintels, gates and porches. Many interior ceilings were made of carved redwood beams and exposed shiplap boards for decorative purposes.

Redwood is used throughout the ranch as an interior and structural material as well. It can be found in the form of hand railings, roof rafters, beams and trusses. The roof trusses of the living hall have required extensive rehabilitation in recent years to prevent a failure due to under design of mechanical connections and construction errors.

As with other materials, "antique" was a highly sought after quality. All the wood in the construction of the ranch was specially treated to increase its appearance of age. First it was gently burnt with an alcohol blow torch.⁴⁰ The softer growth rings would burn faster than the harder growth rings. As the grain became more pronounced it accentuated the surface's texture. The wood was then brushed lightly with a wire brush to remove the soot. Wood finishes varied depending on the location, use, and desired effect.⁴¹ The process itself was always referred to by the workers and architect as "antiquing."

Much of the interior woodwork has been decoratively carved. Some rooms, particularly in the main house and annex, feature engraved Spanish mottoes and floral patterns appropriate to the local terrain. MacNeilledge used these devices to "lend a great interest to the interior as ornament and [as an] appropriate sentiment of the desert."⁴²

38. "Stucco specifications," C.A. MacNeilledge, June 25, 1927, Manuscript 7, Box 37.

39. Charles Alexander MacNeilledge to Albert M. Johnson, September 14, 1926, Manuscript 5, Box 1.

40. M. Roy Thompson to Albert M. Johnson, May 20, 1927, Manuscript 7, Box 4.

41. *Ibid.*, February 26, 1929, Manuscript 7, Box 7. There are numerous references to wood finishes in the Scotty's Castle manuscript collections.

42. Charles Alexander MacNeilledge to Albert M. Johnson, March 1, 1927, Manuscript 5, Box 1.

Other kinds of specialty woods were utilized, such as eucalyptus for a pole trellis over the courtyard between the main house and annex, cedar for the roof shingles of the Lower Vine Ranch house and its outbuildings, and Douglas fir for much of the wall and roof framing.

METALWORK

Some of the metal hardware and lighting fixtures found at the ranch were custom-designed by MacNeilledge and those under his employ. Once the design was completed, its production was commissioned to several different individual craftsmen and specialty shops in the Los Angeles area. MacNeilledge turned to different manufacturers for different needs, indicating that each had a particular specialty. It has been determined recently, however, that much of the metalwork at the ranch was acquired via catalogue stock.

The lighting fixtures are perhaps the most ornate examples of metal work on the ranch. Most of them were produced by Julius Dietzmann Ironworks in Los Angeles. It was not unusual for MacNeilledge's employees and those of Dietzmann to collaborate on their designs.⁴³ Lighting fixtures were special enough to warrant men in Dietzmann's employ to come to the ranch to install them.⁴⁴

Many of the lighting fixtures, and in particular the barn gates, utilize desert wildlife imagery, such as the bobcat, roadrunner, and snake, in their design. Some minor pieces of metalwork, especially those not immediately visible, were ordered from stock or produced on site. If a piece arrived that was improperly made there were facilities available at the ranch to modify it. The metalwork was burnt with a torch, generally on site, to give it "an antique appearance."⁴⁵ The process was similar to that used for wood.

Full lots of hardware and decorative pieces were shipped to the site and never installed. They have been accessioned by the museum staff, but to date have not been catalogued. Once examples of each type have been catalogued, duplicates can then be used as replacements, should the need arise.⁴⁶

43. *Ibid.*, October 31, 1928, Manuscript 5, Box 2.

44. Charles Alexander MacNeilledge to Miss Devlin, July 1, 1929, Manuscript 7, Box 8.

45. *Scotty's Castle Furnishings*, p. 23; Charles Alexander MacNeilledge to Albert M. Johnson, February 7, 1927, Manuscript 5, Box 1; and Charles Alexander MacNeilledge to M. Roy Thompson, November 18, 1927, Manuscript 7, Box 20.

46. Data gathered by Richard A. Bernstein during conversation with Jud Tuttle, Museum Technician, Scotty's Castle, September 1987.

TILE

The prolific use of tile is a characteristic of Death Valley Ranch. A small portion of the tile was imported from Spain, while the remainder was fabricated in the Glendale area just outside Los Angeles, a tile-making center from the 1920s until the early 1950s. Although not to the same degree, the area retains a number of tile-making enterprises today. Many of the tiles made locally for the ranch were designed to resemble and imitate the "Spanish Style" so popular in southern California at the time.⁴⁷

MacNeilledge produced the designs and then found shops and craftsmen in the Los Angeles area to perform the work. In January 1927, MacNeilledge ordered the first full train car-load of tile. By then he had devised three separate tile categories in terms of their purposes:

All the floor tile, exterior tile, and ornamental tile have been ordered. They are all hand made and require about 2 months to make. I am sure you will agree with me they are most unusual.⁴⁸

The exterior tile was used primarily for roofing, and the floor tile was employed on both the interior and exterior. The ornamental tile had a colored glazing and was generally used for decorative purposes only. As with the ironwork, the production of different categories of tile were contracted to various shops and suppliers. Because there were so many suppliers, it is difficult to determine which company made the tile used in each particular instance.

Much of the tile ordered for the swimming pool and its adjacent area was imported from Spain, following MacNeilledge's trip to that country in late 1929. The Spanish tile caused some complications, for at one point MacNeilledge had to send a list of Spanish translations to the site so that the workmen could understand what was stamped on the back of the tile and thus know where the tile was to be placed.⁴⁹

Setting tile on floors or walls was very different from roof-tiling installation, and therefore required a different type of craftsman. One of the tile-setters from 1926 to 1927, Joseph Forcellia, was interviewed and remembers working on the castle. Forcellia recalls how MacNeilledge would inspect the work about twice a month and give the tile-setters just enough work to keep them occupied until he returned. There were never any drawings or plans put to paper that were ever shown to the workmen. If MacNeilledge did not like the way the completed work turned out he would often have it torn up and redone.⁵⁰

The upper face of all the tile was coated with a liquid wax before it was set in place. This prevented any grouting or plaster from sticking to the surface of the tile. It was important not

47. Interview of Pat Calhoun by George Voyta, December 29, 1982, n.p.

48. Charles Alexander MacNeilledge to Albert M. Johnson, January 31, 1927, Manuscript 5, Box 1.

49. Charles Alexander MacNeilledge to M. Roy Thompson, February 20, 1930, Manuscript 7, Box 21.

50. Interview of Joseph Forcellia by [anonymous], May 1971, n.p.

to get any wax on the sides or on the under face of the tile, as this might have an adverse effect on the tile's proper bonding.⁵¹

The tile ranged in size from 6" x 6" to as large as 12" x 12". Those that had a glazed finish were susceptible to "crazing," which refers to the spiderweb-like cracks that develop in response to the cooling down process after firing or to fluctuations in temperature. Most of the tile-makers of the day added talc to the glazing mixture to prevent this occurrence.⁵²

Once delivered, most of the tiles were "backed off." This term refers to how the workmen would take a chipping hammer and bevel the back edges of the tile. It was important to achieve a level and flush plane once the tile was set in place. Because the tile was often either warped or of uneven thicknesses, the beveled edge made it easier to manipulate each tile and achieve this level surface.⁵³

MacNeilledge specified in his instructions that all the finished joints were to be convex, which added considerably to the time it took to accomplish the work. The tile-setters poured the grouting through a funnel. Once it had been allowed to set and gain a little body, they then tooled it with a specially prepared hacksaw blade; a different blade was used for a differently sized bead or joint. Because of these particular specifications, as one tile-setter recalls, it took three times longer to accomplish the grouting than it took to set the tile itself.

Normally the tile-setters would wait until all the other craftsmen had finished before they would start on a room. It was very important that no one walk on the tiles just after they were put in place. Each step of the process was followed with a two-day waiting period, sometimes more, to let the materials properly cure and to effect a strong and durable bond.

The first step was to lay a "float-bed" for the tile to rest upon, usually consisting of a four-to-one mixture of sand to cement. The grouting consisted of a three-to-one sand-to-cement ratio, which resulted in a slightly richer mixture. The richer mixture was easier to smooth out and helped to establish a slicker surface.

Next the tile itself was laid in place. Calculations on where to lay the tile had to be very exact, because it was essential that the end result be "full-tile," meaning no cuts or half-size pieces along the edges. The grouting in between the tile varied in size from 3/4" to 1" in width.

A large amount of tile was purchased, shipped to the ranch, and never utilized. Most of it was intended for the swimming pool and its surrounding area. The remaining tile is stored in the tunnels beside the pool. A project to catalogue all these tiles is now underway and partially completed.

51. *Ibid.*

52. Pat Calhoun Interview, n.p.

53. *Ibid.*

ORGANIZATION OF CONSTRUCTION SUPERVISION

Sometime before September 1926 MacNeilledge suggested to Johnson that Thompson should be replaced with someone more experienced and familiar with "actual building construction." In reply Johnson wrote:

You suggested to me the possibility of getting a man that was more familiar with actual building construction than Mr. Thompson and thought possibly the man who had made the estimates for you would be a good man and would also be available. It was not my idea to supersede Mr. Thompson but to let Mr. Thompson have general supervision and oversight, looking after the office and outside work and have the man suggested, or some other, in immediate charge of the work on the house.⁵⁴

With that directive began a basic division of supervision that remained in place until all construction ceased. Thompson's official title became general superintendent. He was instructed to report to Johnson by mail once, and if possible, twice a week. These reports were meant to keep Johnson informed of all progress made at the ranch in his absence. These procedures began as soon as Thompson arrived at the ranch in November 1925, and well before this division of labor became official. Other personal employees working for Johnson also made regular progress reports.

In December 1926 the reports Thompson sent to Chicago took on an added dimension, because he started to illustrate them regularly with photographs. The photographs were sent with amazing consistency, and they proved a real joy to Johnson. Because of his continuing business responsibilities he could not be at the ranch as much as he would have liked and could not witness for himself the construction of his new house and home. Thompson became quite intrigued with many different photographic practices and within a few years became quite an adept amateur. His photographs, which fill two albums compiled by the Johnsons, include several stereoscopic and panoramic views.

The other supervisory position was formally titled building superintendent and was established at nearly the same time that Thompson started taking construction photographs as a normal part of his routine. Having a second supervisor might have allowed Thompson more time for other duties, such as the photography he pursued so adamantly.

At least four different men filled the position of building superintendent. The first was F.X.A. Kreil, who probably assumed his position in October 1926.⁵⁵ He wrote directly to MacNeilledge on a regular basis, who often wrote directly back. In April, MacNeilledge fired him, following a visit to the ranch because of "numerous mistakes he had made."⁵⁶

In Kreil's place MacNeilledge installed H. Brewster Brown. Brown had been working at the ranch since January as a carpenter. It seems, however, that most of his previous work experience had been with masonry. He held this position for three years and became a trusted employee

54. Albert M. Johnson to Charles Alexander MacNeilledge, September 16, 1926, Manuscript 5, Box 1.

55. The first mention of F.X.A. Kreil on the payroll is in October 1925. Manuscript 7, Box 26.

56. Charles Alexander MacNeilledge to Albert M. Johnson, February 25, 1927, Manuscript 5, Box 1.

of Johnson's. At one point he composed a design for one of the buildings at the ranch. The structure was never built, but the design still survives. Brown left his position in anger, because Johnson would not allow him to go to Los Angeles a week or two before the summer shut-down to undertake another temporary but lucrative job prospect.⁵⁷

Chris J. Johnson was given the position shortly after Brown quit. He had been employed as a carpenter since June 1926. Once officially in charge, Johnson, like Kreil, would often communicate with MacNeilledge directly.

To be able to reduce wages without hostilities the present crew was fired in February 1931. An entirely new crew of workers was hired and a new building superintendent, W.D. MacLean, was hired to replace Johnson soon thereafter. MacLean had a substantial amount of previous construction experience using concrete, which Thompson thought very important.⁵⁸ This is understandable since almost all the projects then underway (i.e. swimming pool, entrance gates, west patio, etc.) primarily involved concrete. MacLean continued to hold this position until all construction ceased in August 1931.⁵⁹

The building superintendent spent most of his time working directly on a particular project, as well as supervising the work of everyone else. Although MacNeilledge, as the architect, was primarily responsible for hiring skilled craftsmen, there were times that the building superintendent would assume the responsibilities of hiring and firing. A separate foreman, besides the building superintendent, would manage the manual laborers, mostly Indians, whose assigned tasks, like fencing the perimeter, would often take them a distance from the main complex. They were not trusted by Johnson to work without direct supervision.

The building superintendent's authority was equal to that of Thompson's as general superintendent, but Thompson was paid \$400 a month and the building superintendent \$70 a week. Thompson was primarily responsible to Johnson. The building superintendent, however, was directly responsible to MacNeilledge in almost all matters. Having two individuals with equal authority led to friction between the two. In 1927, MacNeilledge commented:

[T]hat there is a little dissension between Kreil and Thompson which I hope to adjust when I go up next week. I may find it necessary to replace Kreil or instruct Thompson not to interfere with the building supervision.⁶⁰

In November 1929 a complete reorganization of the work force was implemented at Johnson's behest. It was at that point that the building superintendent was made directly responsible to the general superintendent. Scott had spoken with Johnson and Thompson about this

57. M. Roy Thompson to H.B. Brown, May 20, 1930, and M. Roy Thompson to Albert M. Johnson, June 6, 1930, Manuscript 7, Box 11.

58. M. Roy Thompson to Albert M. Johnson, March 2, 1931, Manuscript 12, Box 4.

59. "Last and Final Payroll," August 23, 1931, Manuscript 7, Box 42.

60. Charles Alexander MacNeilledge to Albert M. Johnson, February 11, 1927, Manuscript 5, Box 1.

reorganization, in which he had quoted Henry Ford: "You cannot have two or more heads running the same enterprise. Always there must be some one man whose authority is final."⁶¹

At the same time the building superintendent was made responsible for hiring and firing. The earlier practice caused some problems. Because MacNeilledge did not live on the site he was not always aware of the labor needs of the ranch and would at times send up men whose skills were not needed.⁶²

The work-team principle was still being utilized, as it had been under Kropf. Over time, however, it became increasingly more specialized and formal. Beginning in December 1925, Thompson, as part of his responsibility for recording the payroll, would put a capital letter by each employee's name to indicate the kind of work that was performed. Ten different team categories were developed: carpentry, grading land, chauffeurs (hauling), masonry and concrete, blasting, excavating, fence construction, plumbing and pipe laying, cooking, and wiring.⁶³ In this way different stages of several projects could be conducted simultaneously.

By January 1928 Thompson had drawn up a more definitive list of labor categories, labeled "Schedule of Labor and Classification," that superseded the one he had employed previously. The revised list had a total of seventeen categories and included, with several exceptions, all those previously mentioned. It did add, however, supervision, plastering, drivers and stablemen, farming and domestic labor, lathing, office employees, and roofing. Masonry and concrete were further divided into four separate classifications, i.e. tile, stone and mosaic work, concrete foundations, concrete sidewalks and floors, and masonry (not otherwise classed). Although the headings of blasting and fence construction were dropped, these categories of work continued to be performed and were probably accounted for under other headings.⁶⁴

This major re-organization was probably precipitated by the dramatic increase in the number of employees, as well as the increase in the amount of work at the ranch. It was at this point that Johnson employed more people than at any other time. The bi-weekly payroll for December 16-30, 1927, lists the names of ninety men and exceeded \$5,000.⁶⁵ This was some one thousand dollars more than the weeks before or since, but was indicative for that particular construction season and the three seasons thereafter. The payrolls for the years 1927 through 1930 were \$64,000 or more. The years 1925, 1926, and 1931 were all less than half that total.⁶⁶

61. M. Roy Thompson to Albert M. Johnson, November 9, 1929, Manuscript 7, Box 9.

62. M. Roy Thompson to Charles Alexander MacNeilledge, December 10, 1929, Manuscript 7, Box 26.

63. M. Roy Thompson to Albert M. Johnson, December 31, 1925, Manuscript 7, Box 26.

64. "Schedule of Labor and Classification," M.R.T., January 28, 1928, Manuscript 7, Box 26.

65. Payroll Records, Manuscript 7, Box 42.

66. Payroll records for 1925 cover only the months of November and December.

WORKING CONDITIONS AND CAMP LIFE OF LABORERS

Working conditions under Thompson varied. For the first several years under his supervision an eight-hour day was the standard. In March 1929 a nine-hour day was instituted, and in response several Indians quit.⁶⁷ The construction season varied somewhat from year to year. Generally, the Indians began working in September and the white crew started work in October.

Construction was temporarily suspended every year during the hottest summer periods. Sometimes the winter cold or heavy snow would force Thompson to halt work until conditions improved. Winter shutdowns of this type did not occur every year and generally did not exceed a week in duration.

As mentioned earlier, segregation between white and Indian employees was rigorously enforced. Any white found visiting the Indian camp was immediately fired.⁶⁸ Living conditions of the two groups varied. Room and board, including a full three meals a day, were provided for all the white employees, the costs of which were deducted from their wages. Most of the men lived in crude temporary structures made of anything available (e.g., corrugated sheet metal). Often, however, there was not enough housing to accommodate everyone, and some men were forced to sleep in the open air.⁶⁹

The Indians, however, provided their own tents or wickiups and established their camp just beyond the boundaries of Johnson's land, the location of which varied from year to year. They must have also provided their own food for no deductions for such items are recorded in the weekly payroll. They did at times purchase food and sundry items from Thompson, but only on an irregular basis.

For a few years at least, the ranch supplied itself with fresh eggs and raised its own turkeys and chickens. The remainder of the food supplies were shipped by train to Bonnie Claire from either Tonopah or Los Angeles. There were no cows on the ranch, so all the milk was from a can.⁷⁰

Johnson vehemently opposed any drinking at the camp. There were, however, three incidents when the problem of carousing and drinking was so extreme that a whole group of men, both white and Indian, were fired and the entire camp closed down temporarily.

In September 1930, Johnson imposed further restrictions on all those working for him. Thompson reported the following implementation of Johnson's wishes:

All employees have signed new working agreement including a clause permitting us to inspect all cars leaving camp, and also to the effect that men interested in prospecting

67. M. Roy Thompson to Albert M. Johnson, March 6, 1929, Manuscript 7, Box 7.

68. M. Roy Thompson to Charles Alexander MacNeilledge, April 14, 1927, Manuscript 7, Box 4.

69. M. Roy Thompson to Albert M. Johnson, September 17, 1930, Manuscript 7, Box 12.

70. Melba Kropf Ford Interview, p. 24.

will not be retained on the job. No men under 24 years old are employed, and we have cut off the aged ones, as per our talk.⁷¹

Nonetheless, Johnson was fully aware that the Depression put many men, especially in the building trades, out of work and that the situation could be worked to his advantage. In fact, Johnson had the present crew fired and an almost entirely new work force hired in September 1930 for the sole purpose of reducing the rate of pay for each position. Thompson reported to Johnson on September 17:

The work started up in full force again yesterday morning, at a total reduction in wages amounting to more than \$25.00 a day under last season's schedule. Carpenters are now getting \$6. a day and board and Indians \$3. without board. Other men have been reduced in proportion, and all seemed to take the reduction in good spirit.⁷²

The firing of one crew and the hiring of another was repeated in February 1931 to take advantage of the falling wage scale as a result of the Depression. The turnover of employees was incredibly high, enough so that Scott, more the front man and the astute witness than the participant, had been known to say that it took three crews to make any progress: one coming, one going, and one working.⁷³

71. M. Roy Thompson to Albert M. Johnson, September 17, 1930, Manuscript 7, Box 12.

72. *Ibid.*

73. Johnston, *Death Valley Scotty*, p. 106.

LANDSCAPE DEVELOPMENT

Before Johnson took possession of the land in Grapevine Canyon, much of it had already been cultivated. Found within the grounds were various fruit trees (i.e., pear and apple), a grape vineyard, and a fig orchard. The vineyard and the fig trees were located south of the garage and were irrigated and tended by the work force. Scott often made his own wine and canned his own figs. It is uncertain when these particular features were lost or destroyed, but they were still producing fruit as late as 1930.⁷⁴

Before a formal landscape plan was devised, it was a common practice to move and transplant trees to locations thought more suitable.⁷⁵ Thompson had previous landscape design experience and had hopes that he would be assigned the tasks of landscaping the ranch. In October 1926 Thompson wrote E.W. Moyers, the manager of the Shadelands Ranch, Bessie's childhood home outside San Francisco, asking advice about nurseries and where one could obtain ornamental trees and shrubbery appropriate for Death Valley Ranch.⁷⁶ As late as March 1931, Thompson still harbored hopes that he would have the chance to finish the landscaping at the ranch:

Naturally I am much interested in the landscaping problems at the ranch, having followed that profession myself, as you know for several years.

During my few days stay here in L.A. this week I am taking the opportunity to inspect many very fine examples of landscaping near here, especially cactus gardens.⁷⁷

As had happened when Thompson prepared his schemes for remodeling the main house, Johnson passed over him and hired someone else. By 1929 Dewey R. Kruckeberg was selected as the landscape architect for the ranch. MacNeilledge and Kruckeberg worked very closely together in preparing the layout of the grounds. It seems likely that Kruckeberg was a friend or associate of MacNeilledge's and that Kruckeberg was recommended for the position by MacNeilledge.

Kruckeberg had worked for Theodore Payne Nurseries in Los Angeles until September 1929 and then began an independent career as landscape architect. Perhaps his commission with the ranch was lucrative enough to influence him in his career move. In any case considerable planting had already been accomplished at the ranch by that time. In fact Thompson wrote to Kruckeberg to inform him that four varieties had died since they were first set out. Eight others, however, continued to live.⁷⁸

74. M. Roy Thompson to Albert M. Johnson, February 28, 1929, September 24, 1930, Manuscript 7, Box 7.

75. *Ibid.*, January 27, 1929, Manuscript 7, Box 7.

76. M. Roy Thompson to E.W. Moyers, October 6, 1926, Manuscript 7, Box 2.

77. M. Roy Thompson to Albert M. Johnson, March 2, 1931, Manuscript 12, Box 4.

78. Dewey R. Kruckeberg to M. Roy Thompson, September 28, 1929, Manuscript 7, Box 20. The following varieties lived: California holly, California lilac, California cherry, sugar bush, wild grape, evergreen honeysuckle, pink cherokee, and *Bremontia Mexicana*. The four varieties that died were California lilac, moss verbena, verbena hybrida, and greasewood. M. Roy Thompson to Dewey R. Kruckeberg, September 20, 1929, Manuscript 7, Box 20.

By 1928 the ranch had begun purchasing jasper from local mines in which the mineral could be found.⁷⁹ Its most prominent use had been for the waterfall in the living hall of the main house. That same stone, mostly red and orange in color, was used for the terracing that Kruckeberg designed. In 1930 the sloped areas in front of the cook house and the guest house were treated in this fashion.⁸⁰ Much of the actual stonework was done by Kruckeberg himself and a Mr. Keil, a man sent up to the ranch by Kruckeberg. Keil lived at the ranch and was put directly on the ranch's payroll. In one of his many regular progress reports to Johnson, Thompson appraised Mr. Keil's abilities in the following manner: "[Keil] is I believe Mr. Kruckeberg's right hand man and has been trained in Mr. Kruckeberg's methods and style of landscaping."⁸¹ What those methods or that style were can only be judged by the results themselves, for little is known about Kruckeberg personally or other designs for which he might have been responsible.

In 1930 many large trees and cacti were transplanted to the ranch, some from as far away as Arizona. Kruckeberg made at least two trips in this automobile to Arizona to locate some saguaro cacti. Kruckeberg hoped to hire Tolson, a local truck-driver, to haul these to the site. It seems that Thompson suggested as an alternative having one of the ranch's own vehicles follow Kruckeberg. Once located, dug up, and prepared for travel the cacti would be hauled back to the ranch.⁸²

The saguaros were eventually planted in a low relief terrace between the guest house and the garage.⁸³ None of this original terrace survives today, perhaps because it was meant as a temporary solution. Apparently, the saguaro did not do well at this altitude and climate, for none survives at the ranch today.

Kruckeberg designed a mounded rock-lined watercourse to replace the terrace in the area between the guest house and the garage. Work on it began in October 1930 and was completed the following winter.⁸⁴ The finished work included two large pools and approximately 110 feet of rock work on either side of a babbling man-made stream. A locally discovered petroglyph was moved to the site and incorporated into the design. It stands just to the south of the stream's west end and its final fall before disappearing underground. The relocation of this petroglyph and other large boulders required the use of Model 30 caterpillar tractors, large trailers, and as many as five workers at a time and several man-hours to accomplish.

Other watercourses similar in design were planned but never constructed. Excavation for one, slated to emerge from behind the guest house and to cross the entrance court east of the main

79. M. Roy Thompson to Albert M. Johnson, February 28, 1928, March 11, 1928, Manuscript 7, Box 6.

80. *Ibid.*, June 27, 1930, Manuscript 7, Box 11.

81. *Ibid.*, February 16, 1931, Manuscript 12, Box 4.

82. There is an invoice for a \$200 shipping charge from Cashman & Stromer of Kingman, Arizona. The charge is for shipping "1 Load Cactus from Rudy's ranch south of Yucca, Arizona, to Death Valley Ranch, California." The invoice is dated July 23, 1930. Manuscript 15, Box 1, Book 3.

83. M. Roy Thompson to Albert M. Johnson, June 27, 1930, Manuscript 7, Box 11, and M. Roy Thompson to Charles Alexander MacNeilledge, July 5, 1930, Manuscript 7, Box 12.

84. M. Roy Thompson to Albert M. Johnson, June 27, 1930, Manuscript 7, Box 11, and Dewey R. Kruckeberg to Albert M. Johnson, January 12, February 16, 1931, Manuscript 7, Box 20.

house, was started but did not get very far.⁸⁵ This watercourse was to empty directly into the swimming pool. A third was planned as a feature just west of the diving platform at the northwest corner of the swimming pool. Neither the diving platform nor the watercourse ever got beyond the planning stage.

Other plantings throughout the grounds included the introduction of full-grown olive and palm trees. Three Washingtonian palms were shipped to the ranch by Tolson from San Bernardino. They were planted in early March 1930 as the central focus of the entrance court east of the main house.⁸⁶ Plans included having the three trees surrounded by a low relief terrace whose borders would be delicately defined by a very simple row of small stones, but that was never accomplished. All three trees died because of the severely cold temperatures during the winter of 1938-39.⁸⁷

Olive trees were procured from George Webster's olive ranch in San Bernardino and also shipped to the ranch by Tolson's flatbed truck. Thompson informed Johnson on April 10, 1930, that the "first olive trees are on their way up and are expected to arrive today. Kruckeberg will supervise their planting."⁸⁸ The landscape design work at the ranch was soon halted, and it as not resumed until after World War II.⁸⁹

85. M. Roy Thompson to Albert M. Johnson, September 24, 1930, Manuscript 7, Box 12.

86. *Ibid.*, May 8, 1930, Manuscript 7, Box 11.

87. Johnston, *Death Valley Scotty*, p. 156.

88. M. Roy Thompson to Albert M. Johnson, April 10, 1930, Manuscript 12, Box 4.

89. For further data on this topic see the discussion in this study concerning the Gospel Foundation.

FENCING

One distinguishing feature of Death Valley Ranch is its concrete post fencing. One estimate calculates that over 2,000 of these particular posts were made on site and used to define the perimeter of the lands Johnson claimed.

As early as January 1926, eight-foot reinforced concrete posts were manufactured at the ranch. Thompson briefly described the process, probably after his initial experience with it:

[The implement room of the shed] makes a fine space for curing concrete posts. We have made five of them, with four re-enforcing rods, and they look good. I stamped the branding iron circle-J on each of them. This way of making posts is about perfect I think, as the shaking system makes a compact and dense concrete of great strength.⁹⁰

All the concrete fence posts were made on site, usually by Indians, utilizing the "D & A Post Mold System." This system was manufactured and marketed by the "D & A Post Mold Co." of Three Rivers, Michigan. G.H. Dougherty was listed on the letterhead as secretary. The steel fencepost molds were filled and covered with sawdust or straw to cure the concrete better. The molds, once full, were shook for some unknown length of time to settle the cement and make it more compact.⁹¹ Some of the fencepost molds made by the D & A company survive and are presently stored in the stables.

As the need for enclosing additional lands increased, Thompson attempted to have the crew make a daily quota of ten to twenty posts.⁹² Once the new gravel bunker in the wash southwest of the main complex was operational the scene of making these posts was relocated nearby. Stockpiles of unused fence posts still survive near the gravel bunker in various states of decay. Some were requisitioned by the National Park Service in the early 1970s for the reconstruction of fences throughout the grounds.

Three different types of posts were formed. The majority were rounded with one side flattened. The second most numerous were those used for supplemental bracing. These were completely square and much broader. They were generally used either as corner posts or as gate posts. A third type was formed with small triangular shelves attached to support horizontal cross beams for locations that required greater strength.

In March 1929 three-foot extensions for the molds were purchased.⁹³ This permitted the production of eleven-foot as well as eight-foot posts. Thompson felt that because the bottom three feet would be buried below grade, the seams these extensions caused would not be visible and therefore not mar their appearance.⁹⁴ The eleven-foot post was preferred for the Upper

90. M. Roy Thompson to Albert M. Johnson, January 21, 1926, Manuscript 7, Box 1.

91. D & A Post Mold Co. to M. Roy Thompson, March 19, 1929, Manuscript 12, Box 1.

92. M. Roy Thompson to Albert M. Johnson, February 20, 1929, Manuscript 7, Box 7.

93. *Ibid.*, March 17, 1929, Manuscript 7, Box 7.

94. *Ibid.*, February 20, 1929, Manuscript 7, Box 7.

Ranch because it was thought that they would lend a greater protection to the Johnsons and their guests.

Installation of the fencing was done by Indians. One crew would dig the holes and set the posts while another would follow behind stringing the wire. Most of the posts were set fifteen feet apart. In other instances, they were set as close as twelve feet and as far apart as twenty-five feet. The spacing usually depended on the amount of protection each location required. Steep hillsides far from a road or regular traffic did not require the posts to be as closely spaced as those directly next to a gate or beside a traveled roadway. Either three or five strands of barbed wire were strung between fence posts. Those areas closer to a gate or a road were furnished with woven-wire fencing. Like the spacing of the posts, the amount of traffic the location witnessed normally determined the amount and type of wiring it received.⁹⁵

Much of the fencing was set along very steep hillsides. To transport the fence posts they were placed on a steel plate devised by Thompson. The device was known as a "steel fence-post sled" and hauled by mules. The device was "eight feet long with three steel runners on the bottom made of wagon tire steel."⁹⁶

Almost every fencepost was stamped with a "brand" characteristic of the ranch. The earliest posts were stamped only with a circle-J, the initial of Johnson's name. Very few of these are extant. Virtually all the earliest fence posts were either lost in floods or decayed over time.⁹⁷ Later a circle-S, representing Scott, was added. At first the J was always above the S, but at some point this was reversed. It is unclear why this decision was made, unless it was to further enhance Scott as the principal figure in the construction of the "Castle."

95. *Ibid.*

96. *Ibid.*, July 20, 1928, Manuscript 7, Box 6.

97. The only such fencepost found to date is south of the entry road off the main road, some one hundred yards beyond the entrance gates.

TUNNELS

Another distinguishing feature of the ranch is its network of underground tunnels. An attempt was made to link each of the individual buildings with seven-foot-high concrete passageways. A few were actually completed, while some simply come to a dead-end. Like most things at the ranch, construction of the tunnels was accomplished in phases. When a new building was nearing completion, excavation for a full underground passageway and all the necessary services would normally follow.

Plans for a tunnel system were being discussed and implemented as early as February 1927. The purchase of a steam-powered shovel in 1929 expedited matters and was primarily responsible for much of what was actually accomplished. The principal purpose of these tunnels was to facilitate the installation of necessary services. On September 21, 1930, Thompson reported to Johnson:

I find it will be necessary to make a tunnel to serve [the servants' quarters] from the present patio tunnel in order to install the steam pipes, electric conduits, hot and cold water pipes, drains and sewers, and this tunnel will also contain the service pipes and drain from the grotto fountain.⁹⁸

Having all the piping and all the conduits exposed and easily accessible provided for easier and more convenient repair as well.

More fanciful accounts that tried to explain the purpose these tunnels served purported that they were built so the help could move from one building to the other without being seen on the grounds and attracting undue attention. Other stories indicated the tunnels might be an emergency shelter in case of attack, a hiding place for Scott's gold, and perhaps the entrance to the secret mine Scott so often boasted he had.⁹⁹

Johnson was likely familiar with the tunnel system of Chicago's downtown Loop, providing him with the original inspiration for such a system at the ranch. Chicago's subterranean network, the construction of which began in 1907, included a narrow-gauge railcar system for the underground transportation of freight and fuel. By 1914 there were 62 miles of tunnels and approximately 650,000 tons of freight being delivered through them. The objective was to alleviate the daily congestion within the streets of downtown Chicago.¹⁰⁰

Certainly, congestion was not a problem at the ranch. Johnson, however, was taken with the idea and wished to have something similar for himself because he liked the concept. Although perhaps only coincidental, it is interesting to note that the house Johnson acquired on Lake

98. M. Roy Thompson to Albert M. Johnson, September 29, 1930, Manuscript 7, Box 12.

99. Interview of Burton Frasher, Jr., by Steven Harrison, January 22, 1980, p. 21; Interview of Lloyd Davey by Gary Hathaway and Steven Harrison, April 1, 1978, n.p.; and Johnston, *Death Valley Scotty*, p. 131.

100. Harold M. Mayer and Richard C. Wade, *Chicago: Growth of a Metropolis* (Chicago, University of Chicago Press, 1969), pp. 216-18.

Michigan was built by and purchased from Albert G. Wheeler, the developer of the tunnel system in Chicago. The house had a tunnel of its own from the main house to the garage.¹⁰¹

Because the tunnels were not a matter of "architectural importance" MacNeilledge was never involved in their design or construction. Although Johnson often offered his ideas and, at times, directions, it was Thompson that was probably most responsible for their layout. In a report to Johnson on March 31, 1929, Thompson noted:

I am working out the various problems involved in the proposed tunnel under the lake and dam, the lake drainage, pipes, etc., and will soon send you cross sections profile and plans of same.¹⁰²

101. Johnston, *Death Valley Scotty*, p. 103.

102. M. Roy Thompson to Albert M. Johnson, March 21, 1929, Manuscript 7, Box 7.

LANDOWNERSHIP ISSUES

In the late 1920s proposals for making Death Valley a component of the National Park System came to the fore. On July 25, 1930, President Herbert C. Hoover signed Executive Order 5408. This order withdrew more than two million acres of land from the public domain pending the outcome of further park studies. Within months U.S. Government surveyors were mapping the as-yet-uncharted lands within the valley. The survey team, headed by U.S. Transitman Roger Wilson, used Death Valley Ranch as a base camp and supply station, often purchasing food and equipment from Thompson. Wilson kept Thompson informed of the survey's progress and findings. In December 1930 Wilson apprised Thompson of an "unexpected situation" that "might possibly throw the [new] township line right through the main house."¹⁰³

The following January, Wilson explained the situation in detail to Thompson who immediately recounted it to Johnson. In his account Thompson wrote:

He [Wilson] says that under his present instructions the survey will place the township line north of the main house about one half mile, thus making all the improvements fall into the Park limits. This situation is caused by the wide discrepancy between Surveyor Bond's Saline Valley survey of 1880 and Surveyor Baker's Death Valley survey of 1884 which latter survey throws every corner one mile north and one mile west of where the corners would be if the 1880 survey were projected easterly. The 1884 survey is so incorrect that it might be advisable to throw it out entirely and bring in new lines from the 1880 survey from Saline Valley, but this cannot be done without instructions from the higher officials in the land department at Washington, D.C....If you could influence the General Land Office in Washington to order this to be done it will straighten out the situation here so that the Saline Valley survey will govern and thus throw all the improvements north of the park boundary line. But Mr. Wilson says that this will have to be done quick to have any change made in his present surveys.¹⁰⁴

Wilson, like all government surveyors, was tied to a method of surveying that had been honored since the days of George Washington. In any circumstance such as this, where there were two surveys with a sizable discrepancy, the land in between the two already-recorded surveys would be sectioned off into irregular lots, enough so that the new section lines join preceding surveys' lines – thereby including the ranch's lands in the proposed national monument.¹⁰⁵ Although Johnson was advised by Thompson and a surveyor/lawyer, Edwin S. Giles, that Johnson's "squatter's rights will give you precedence over the Death Valley withdrawal, so that you will get the land you improved, regardless of the position of the township line" he needed additional information to be sure what this would mean.¹⁰⁶

One month later Johnson went to Washington, D.C., to meet with Senator Tasker L. Oddie, Congressman Samuel S. Arentz, and others. On February 18, 1931, Johnson met with NPS

103. *Ibid.*, April 10, 1931, and December 30, 1930, Manuscript 7, Box 13.

104. *Ibid.*, January 16, 1931, Manuscript 12, Box 4.

105. *Ibid.*, January 27, 1931, Manuscript 12, Box 4.

106. Albert M. Johnson to M. Roy Thompson, January 23, 30, 1931, and Edwin S. Giles to Albert M. Johnson, January 4, 1931, Manuscript 12, Box 4.

Director Horace M. Albright and explained that his land and improvements might be located within the proposed park boundaries. Albright suggested that Johnson find out, prepare a description of the land, and send it to him. Albright promised to have a presidential order drawn up and executed restoring the land for entry. In other words, the land would be in the public domain once again and open to a new claim.

The meeting proved useful for Albright as well. Johnson, more familiar with the valley than Albright, suggested that he redraw the park's boundaries farther south to include Silver Lake. At the same time Johnson recommended certain sections of the valley that would require new roads if they were to be traveled safely by tourists.

Later that same day Johnson had dinner with Congressman Arentz, a frequent visitor to the ranch. Arentz mentioned to Johnson that if all else failed, "he would have a special bill introduced into Congress giving [him] the privilege of locating on the land [he] wanted and buying from the government at \$1.50 per acre."

The following day Johnson visited the General Land Office and met with several individuals involved with the ongoing proposed park boundary survey. During the discussions that ensued Johnson uncovered some important information. He learned that once the land was restored for entry, the solution offered by Albright, war veterans would have a 91-day period in which they had preference over Johnson for filing a claim.¹⁰⁷

Such uncertainty about the continued ownership of the land must have caused Johnson to rethink his plans for the ranch. In February 1931 Johnson instructed Thompson to close the camp for a two-week period and to meet him in Los Angeles to discuss operations at the ranch. One specific goal was to establish a lower wage scale for all workers at the ranch. Thompson investigated present wage scales in the Los Angeles area and believed they could get workers of the same or better quality and still save \$50 a day.¹⁰⁸

A new crew replaced those that were working. A new construction foreman, W.D. MacLean, was hired to replace Chris Johnson. Two of the characteristics that drew Thompson to MacLean were that he "had much experience as superintendent of construction of reinforced concrete buildings...and no false sentiment against letting the weakest man go about every two weeks."¹⁰⁹

The connection between the problems with landownership and MacNeilledge's dismissal is unclear, but they certainly coincide.¹¹⁰ Perhaps, Johnson felt constrained by time and money and wanted an architect that would deliver his drawings on a more timely basis. Perhaps, even more simply, everything Johnson wanted or could hope to finish had been designed and he no longer needed additional design work.

107. Typewritten notes made by Albert M. Johnson, February 20, 1931, Manuscript 19, Box 8.

108. M. Roy Thompson to Albert M. Johnson, February 10, 1931, Manuscript 12, Box 4.

109. *Ibid.*, March 2, 1931, Manuscript 12, Box 4.

110. Thompson was informed by letter on February 26, 1931, that MacNeilledge "ceases to be employed on the work in Death Valley after the end of this month." No additional details were disclosed. Manuscript 12, Box 42.

It was not too long after MacNeilledge's dismissal and the hiring of a new crew that construction ceased. The final payroll was dated August 23, 1931.¹¹¹ Although the most often heard reason for the shut-down has been the effects of the Depression on Johnson's finances, the uncertainty of Johnson's continued ownership of the very land upon which he built seems a more likely explanation. The fact that the gravel separator was expanded in 1930 and the solar heater was constructed during the same period, well after the stock market crash, seems sufficient to disprove that the immediate effects of the Depression caused the shut-down.

In February 1933, President Hoover signed the proclamation making Death Valley a national monument, and the lands it encompassed contained those of the ranch. In August 1935, President Franklin D. Roosevelt signed H.R. 2476, allowing Johnson the right to buy the land in question. In this manner Johnson avoided the possibility of someone with greater priority from claiming the land. It was not until November 1937, however, that the patent was actually issued and the 1,529.83 acres purchased and exchanged. Thus, Johnson was allowed to purchase the lands, he thought already his, for \$1.25 per acre. By this time, however, Johnson had lost much of his fortune and could not afford to resume construction.

111. Payroll, August 23, 1931, Manuscript 7, Box 42.

IMPACT OF THE DEPRESSION ON CONSTRUCTION

The Depression did not immediately affect Johnson's fortunes and directly cause the sudden and final cessation of construction. In fact, it was four years after the crash on Wall Street before the nation's economic condition caught up with him and his project. In 1933 the National Life Insurance Company went into receivership. Johnson had invested a large portion of the company's assets in banking, an activity that was hit especially hard in the 1930s. National Life had purchased over 12,000 shares of Continental Illinois and Johnson was one of its directors. Shares of Continental sold for as high as \$1,400. After the crash shares sold for as little as \$17.¹¹²

The heavy investments Johnson made in a rayon factory in Burlington, North Carolina, only compounded matters. The plant, under construction for several years, never opened and commenced production. The two million dollars Johnson invested included personal and company funds and failed to return a single cent. Much of the money used to finance the rayon venture came from National Life. When National went into receivership, the plant, along with the life insurance company itself, was put on the auction block. National was eventually awarded to Sears, Roebuck and Co. and renamed Hercules Life. The plant was included in the exchange.¹¹³

Some people claim that Johnson's fascination with the castle, the desert, and the isolation the two afforded caused his economic downfall. Johnson had built his hideaway in such an eccentric location because he didn't want neighbors and because he regularly felt the need to escape the incessant pressures of the business world.

Johnson's absences from Chicago were keenly felt at the office. The castle had no telephone and the nearest telegraph station and post office was twenty-five miles away in Bonnie Claire. When matters of great importance surfaced at work Johnson could not be reached. The day-to-day management of the company fell to those who were less able to handle the situation that arose. Several sources document this problem:

Some of those who were closest to Mr. Johnson feel sure that if he had attended more closely to business and had not been away so much of the time in California he would have averted the collapse of National Life. [There are many who] feel certain that he was canny enough that he would have unloaded in time had he been on the job to sniff the financial atmosphere.¹¹⁴

The big fact is that a businessman, address 29 South La Salle Street, saw the valley and became enamored of it to the point where it meant more to him than the money changers and the monkey business of La Salle Street, and spent a great deal of time in the Valley...maybe too much time for the good of the business that he owned.¹¹⁵

112. Levering Cartwright, "A Sacrifice to Death Valley," filed under "Albert Johnson" in Vertical Files.

113. *Ibid.*

114. Anonymous newspaper clipping from Department of Manuscripts and Archives, Cornell University Libraries, Ithaca, New York. Copy on file under "Albert Johnson" in Vertical Files.

115. Cartwright, "Sacrifice to Death Valley."

Although Johnson lacked a steady income once the life insurance company was sold, he did retain substantial private property holdings: the homes in Chicago and Hollywood, Shadelands Ranch, and the castle. His financial situation was serious enough that Johnson sold his home in Chicago. Still a man of great business acumen, Johnson capitalized on what he retained. The house in Hollywood became his principal residence and offered little in terms of income-producing potential. Although the Johnsons were to depend increasingly upon them for an income, the nut and fruit trees of the Shadelands Ranch produced much as they had before the Depression. Only the commercial potentials of the castle itself were yet untapped.

ROAD CONSTRUCTION AND GROWTH OF TOURISM

In the 1920s Death Valley was promoted and developed as a tourist attraction. The fundamental requirement of the region's success, however, was its accessibility to the public. The growing popularity of the automobile as the public's preferred choice of travel required the construction of new roads and the improvement of those already in place, if the area's potential as a public attraction was to be exploited successfully.

Much of the land in Death Valley belonged to the U.S. Borax Company. When the mining of borax became less profitable, the company lobbied for the establishment of the area as a unit in the National Park System and began developing plans for a luxury resort in the valley. Although the idea of establishing Death Valley as a park area was favorably received by Stephen Mather, then the director of the National Park Service, he was reluctant to act. Mather, himself a former Borax executive, thought that if he personally advocated the company's proposal too strongly, it would result in cries of foul play and favoritism. In January 1929 Horace Albright replaced Mather, whose failing health forced him to resign. Although Albright, like Mather, had personal and professional connections with the borax industry, Albright was less fearful of accusations of favoritism, and proceeded quickly in proposing boundaries and drafting tentative legislation.¹¹⁶

At the same time other interests were developing their own projects. In May 1926 Herman William Eichbaum opened a 38-mile scenic toll road through Towne Pass and over the mountains bordering Death Valley to the west. The following November, Eichbaum opened his Stove Pipe Wells Hotel, approximately forty miles south of Grapevine Canyon on the Death Valley floor. Soon thereafter the U.S. Borax Company financed the construction of the Furnace Creek Inn. It opened to the public in February 1927, fifteen miles south of Stove Pipe Wells.¹¹⁷ To the east, on the Nevada side of the castle, new roads were promoted as well. The Western Good Roads and Tourist Routing Association, led by its president C.C. Boak, were in regular contact with the state engineer, Sam S. Durkee. The association successfully lobbied for the state highway between Reno and Las Vegas to be upgraded to Class A standards.¹¹⁸

By 1930 Eichbaum had virtually completed the first improved automobile road north through the valley and up towards the ranch. Its effects were felt at the ranch by mid-May. Thompson observed:

[The two glaziers] drove down the valley this afternoon, on the road that Mr. Eichbaum has been grading. Mr. Eichbaum and his wife drove up this road from [their hotel] to the Ranch in 2 1/2 hours, and many cars are coming over it lately.¹¹⁹

116. Richard E. Lingenfelter, *Death Valley and the Amargosa: A Land of Illusion* (Berkeley, University of California Press, 1986), pp. 464-65.

117. *Ibid.*, pp. 451-54.

118. M. Roy Thompson to Albert M. Johnson, January 13, 1929, Manuscript 7, Box 7.

119. M. Roy Thompson to Charles Alexander MacNeilledge, March 4, 1930, Manuscript 7, Box 10.

The new road made it possible to drive from the ranch to Los Angeles in nine hours.¹²⁰

Eichbaum often told his guests about the "Castle" to the north and suggested they see it for themselves. It was not long after the road was improved that visitors, mostly uninvited, stopped by the ranch for a quick look and sometimes more. The topic of "visitors" became a subject to be included in most of Thompson's progress reports to Johnson. In the spring of 1930, for instance, Thompson wrote, "Forty to eighty [visitors] nearly every day. We do not feed them, except rarely when Scotty gives certain ones special invitation."¹²¹

The number of visitors grew as tourism became more popular and access by car less difficult or dangerous. Less than a year after the road was opened Thompson reported the following to Johnson: "There are about 100 visitors a day driving through here this weekend, because of the double holiday....The two hotels in the Valley are turning dozens of people away each night."¹²²

During the early 1930s Johnson realized the financial promise these visitors had, for by 1934 informal tours of the main house and annex were conducted. By 1936 tour guides had been hired and trained and an admission price of one dollar per person was instituted. Bessie, more so than Albert, administered these tours and was known to conduct a few herself. In his *Death Valley Scotty* Hank Johnston quotes Bessie as stating:

We are now employing about a dozen young men and women under a resident manager to act as guides and guards. The girls are dressed in pretty frocks and make the visitors feel comfortable....Visitors range from a few a day to as high as 130.¹²³

To augment the income derived directly from tour admission charges, Johnson began to sell mementos. Bessie had written a small anthology of stories about Scott in 1932 entitled *Death Valley Scotty by Mabel*. In addition she prepared a written guidebook for the tour of the main house and annex. It was intended to serve two separate functions: first as a training manual for the many employees hired as guides and second as a keepsake for the paying public. Several sketches of the "Castle" by M. Roy Thompson were included to illustrate the text. In 1941 Johnson had 10,000 guidebooks privately published under the business name of the Castle Publishing Company, and made them available for sale to the public as souvenirs.¹²⁴ Johnson observed:

We placed the books on sale the middle of this month [October, 1941] so have had only five days experience and not very many people going through the castle as yet but have

120. M. Roy Thompson to Albert M. Johnson, May 12, 1930, Manuscript 7, Box 11.

121. *Ibid.*, April 15, 1930, Manuscript 7, Box 11.

122. *Ibid.*, February 22, 1931, Manuscript 12, Box 4.

123. Johnston, *Death Valley Scotty*, p. 125.

124. Kenneth K. Wright to Albert M. Johnson, August 29, 1941, Manuscript 19, Box 8, and Albert M. Johnson to Roy O. Day, October 24, 1941, Manuscript 19, Box 5.

averaged ten books a day. We are selling them at \$1.00 each so it looks as though we would sell at least 1/2 of the 10,000 by the first of May.¹²⁵

Although plans to publish Bessie's anthology of anecdotes about Scott and her life in the desert were set they never materialized. The Japanese attack on Pearl Harbor in December and the wartime restrictions on gasoline soon resulted in declining visitation to the castle.¹²⁶

Johnson also envisioned the potential financial value in postcards and in 1929 hired a professional photographer, Burton Frasher, to take dozens of large format photographs. Frasher, working along with son Burton Jr., specialized in publishing postcards and often stayed at the ranch taking photographs of the buildings and grounds as well as the scenery of the surrounding area. Hundreds of photographs of the ranch were taken and thousands of postcards were produced and sold.

125. *Ibid.*

126. See introduction to the soon-to-be-released 1987 reprint of *Death Valley Scotty by Mabel* written by Susan Buchel and published by the Death Valley Natural History Association.

THE RANCH IN DECLINE

In 1943 Albert's wife Bessie died in an automobile accident traveling over a mountain pass forty miles south of the ranch. Albert was at the wheel and had lost control of the car. Bessie was killed instantly. His sorrow over the loss of his wife and life-long companion combined with Johnson's deteriorating physical condition to make it increasingly hard for Albert to visit and properly maintain the property. During World War II gasoline and tires were being strictly rationed. This in turn severely diminished public visitation to the ranch which resulted in a substantial loss in income for the castle, thus serving to make the costs of continued maintenance even more difficult to meet.

THE RANCH UNDER THE GOSPEL FOUNDATION

In 1946 Johnson established a socially oriented charity which he named the Gospel Foundation. He installed Mary Liddecoat as president. She had earned a degree in social work from the University of California, Santa Barbara, and was the daughter of one of Johnson's closest friends, Tom Liddecoat. Tom was a wholesale distributor of produce in the Los Angeles area and had established the Midnight Mission on skid row in Los Angeles. Albert was a frequent visitor to the mission and had known Mary ever since she was a little girl. The Liddecoats often met socially with the Johnsons in Los Angeles and Chicago, and Mary still remembers visiting both the Johnsons' Chicago and Los Angeles homes.

Johnson named Walter Webb as vice-president. Webb, who had worked with different insurance companies since 1907 and had joined National Life in 1927 as an executive vice-president, was next in line to be president of the company had it survived the Depression. Despite the company's downfall, Webb remained loyal to Johnson and was willing to serve the Gospel Foundation in his memory.

In 1947, one year after the foundation had been formed, Johnson made provisions in his will to bequeath several properties to the institution. Besides Death Valley Ranch, it would gain control of the Shadelands Ranch and the Hollywood home. Johnson died on January 7, 1948. Thereafter, the house in Hollywood was used as an office and headquarters for the foundation. The hundreds of acres surrounding the house at Shadelands were slowly sold off, parcel by parcel. Webb, who was in charge of real estate for the foundation, sold the land only to corporations or businesses with large payrolls, reasoning that even if the sale of the land did not bring in the greatest income immediately, the large number of employees associated with large corporations would live in the area and add to the tax base. Today the immediate area surrounding Shadelands is home to research and corporate parks for many large companies. The last parcel of land was sold in 1987.

Johnson included one definite provision in the foundation's charter: that all the assets be spent or discharged in Liddecoat's lifetime. Johnson hoped that this would prevent the foundation from straying into programs foreign to what he envisioned. Today the institution still awards a total of \$400,000 a year in grants to needy socially oriented causes.¹²⁷

Death Valley Ranch had already been established as a motel and tourist site and the foundation continued to operate it in that manner. The shed was renamed the "Rancho" and the guest house was renamed the "Hacienda." The Gospel Foundation divided the latter into four separate rooms and rented them as well. The suites in the castle were available for rent and went for premium prices: \$13 a night with breakfast.¹²⁸ At some point the administration found it needed employee housing more than motel rooms and thus reconverted the "Rancho" for that purpose.¹²⁹

127. Interview of Mary Liddecoat by Susan Buchel, March 17, 1983, n.p.

128. Flyer printed by Gospel Foundation, 1951, Manuscript 7, Box 42.

129. Mary Liddecoat Interview, n.p.

After the Gospel Foundation inherited the ownership and caretaking responsibilities of the ranch it began to add some new landscape features. Mary Liddecoat, president of the foundation and principal caretaker, transported oleanders to the ranch in her car, each time she drove to the ranch from Los Angeles. Over the course of a several-year period, Liddecoat was able to border many walkways and buildings with oleanders, many of which still survive. She also occasionally brought some cacti to plant in the beds just south of the guest house to replace those that had died.¹³⁰

Liddecoat and the Gospel Foundation may also be responsible for the many palm trees that were added after Johnson's death and that dot the present landscape, particularly those near the stables. Those east of the garage and in front of the motel were added after the National Park Service took control, replanting those that grew wild near the stables.

The entrance court was covered with asphalt during the Gospel Foundation's administration. This may have been accomplished close to the time that the wishing well was covered with tile and the additions to the gas tank house and service station were built.

Although attempts have been made to document other maintenance activities and structural modifications performed by the Gospel Foundation, few records were left by the institution. In 1973, for instance, Beamer, Wilkinson & Associates, a firm analyzing the mechanical and utility equipment at the castle under contract, reported:

Over the years of occupancy since the "historic" period, the electrical wiring systems in the Ranch buildings have been modified substantially from the original installation. Portions of the wiring systems were replaced and recircuited by the Gospel Foundation in the 1950's. Workmen...were often inexperienced and the safety and/or adequacy of such wiring is questionable. No organized records or "as-built" drawings of alteration work exists.¹³¹

The report also noted that the refrigerator equipment in the walk-in cooler had been "modified to a degree from the original drive mechanism":

Coils and other controls deviating from the original installation have been installed. The original drive installation has been replaced with an electric motor; some of the original coils have been short-circuited, and temperature controls of a design prevalent in the fifties are in evidence.¹³²

130. *Ibid.*

131. Beamer, Wilkinson & Associates, *Technical Analysis of Mechanical and Utility Equipment, Death Valley Ranch, Scotty's Castle*, 1973, Chap. 5, p. 13.

132. *Ibid.*, Chap. 7, p. 4.

PURCHASE OF THE RANCH BY THE NATIONAL PARK SERVICE

As early as 1933 Horace Albright realized the potential Scotty's Castle might have as an attraction for Death Valley. Although he mentioned it to Johnson in an offhand and jovial fashion when the two first met, it must have seemed somewhat inevitable when it actually happened many years later.

Despite the apparent success of the tours the foundation wished to divest itself of ownership of the castle. In 1970 the foundation found an interested buyer in its neighbor – the National Park Service. That same year the foundation also donated Shadelands to the city of Walnut Creek for use as a historic house museum. These divestitures proved beneficial for the foundation, which was awarded tax-exempt status once it no longer owned the properties.¹³³

The National Park Service purchased the castle and its lands for \$850,000. The funds were made available by the Land and Water Conservation Act of 1965. The Act prohibited the use of these monies for purchasing furniture, so the Gospel Foundation donated the furnishings as part of the transaction.¹³⁴

133. Mary Liddecoat Interview, n.p.

134. Johnston, *Death Valley Scotty*, p. 154.

OPERATION AND MAINTENANCE BY THE NATIONAL PARK SERVICE

Although the Gospel Foundation sold the castle to the National Park Service in 1970, tours, routine cleaning, fire protection, and security were administered under contract by National Parks Concessions, Inc., until 1973. Records indicate that there were many problems relating to operation of the site under this arrangement. Continuation of such difficulties accounted in part for assumption of maintenance and operation of the site by National Park Service personnel in 1973.¹³⁵

During the years 1973-75 storms caused damage to the castle and its immediate vicinity. The second floor south porch roof was partially removed from its decorative metal posts by a wind storm during the winter of 1973-74. Thereafter, Park Service personnel attached wooden posts to support the weakened porch roof.¹³⁶ The following year a flash flood occurred in the canyon, causing some minor damage to the site.¹³⁷

In 1976 Solar-X film was applied to the windows of the main house and annex. The film was removed in 1987 and replaced by 3M "Scotchint" Film #NR20SMARL (Dark Smoke).¹³⁸

The furnace, which had been converted to propane gas by the Gospel Foundation, was reconverted back to original fuel oil operation by the National Park Service in 1977. The work was performed by Gil Potter after a conversion kit was acquired in March 1977.¹³⁹

A contractor was hired to apply linseed oil to the redwood on the exterior of the structure in 1977-78. This work was repeated by Park Service personnel in 1984.¹⁴⁰

In July 1978 a small post office in the annex garage or alcove was removed. The post office had been in that location since the time of the Johnsons.¹⁴¹

135. See correspondence under file code C3823 in Administrative Files Collection. Among the important communications are North District Ranger to Chief, I&RM, DEVA, July 26, 1974; Superintendent, DEVA to National Parks Concessions, Inc., Manager, October 28, 1971; Superintendent, DEVA to National Parks Concessions, Inc., February 1, 1971; President, National Parks Concessions, Inc. to Superintendent, DEVA, November 23, 1970; Superintendent, DEVA to President, National Parks Concessions, Inc., December 14, 1970; and Grapevine Ranger to Superintendent, December 4, 1970.

136. Memorandum, Regional Historical Architect to Regional Director, WRO, March 30, 1977, Administrative Files Collection.

137. Data gathered by James O'Barr during conversation with Don Creech, December 1989, in James O'Barr, "Notes on the Maintenance of Scotty's Castle, Building SC02, Main House and Annex," February 1990, n.p.

138. *Ibid.*

139. *Ibid.*

140. *Ibid.*

141. *Ibid.*

Many leaks exist in the tile walkways that cover portions of the roof areas in the two buildings. Thompson's water sealer has been applied to the annex tile walkway/roof virtually every year since 1983 in an effort to stem such problems.¹⁴²

While the Park Service still operates evaporative coolers in Mrs. Johnson's apartment bathroom and Johnson's office, several swamp coolers have been deactivated or removed in other rooms of the main house and annex during recent years. The swamp cooler in the Italian room was removed in 1973 and that in the upper music room was deactivated in 1978. The swamp cooler in the great hall was deactivated by the summer of 1980.¹⁴³

The fountain in the great hall was leaking badly by the late 1970s, causing some severe deterioration problems. Pat Calhoun, a tile expert and frequent volunteer at the site, was enlisted to study the fountain problem during the summer of 1977.¹⁴⁴

Work on the fountain began in April 1978 at which time the fountain was turned off. A humidifier was installed on the north side of the fountain, and modifications were commenced behind the fountain under the stairway. The staircase was strengthened with steel support braces, and several pipes to the fountain were replaced. An opening in the east wall beside the fountain that held a trap door to the back of the stairs was replaced with a screen to allow air circulation behind the fountain, thus enabling the saturated wood to dry. An epoxy was used unsuccessfully to fill the mortar joints between the jasper rocks that appeared to be leaking. At the top of the fountain a copper reservoir with jets supplied the water for the fall down the jasper rock wall into the fountain basin. Because the reservoir was leaking a hole was punched in the west wall by the stairway, thus allowing the Park Service to install a plastic tube that served as a dribbler down the fountain wall into the copper basin. Holes were put into the reservoir so that it could not be used again, and attempts were made to render the basin leak-proof. The fountain repairs, however, did not solve the problems as the dribbler could not be regulated without splashing over the floor in front of the basin, and the rock around the basin continued to leak. The epoxy caused severe discoloration to the fountain mortar. Despite these problems the fountain was reactivated and continued in operation until 1982 when it was turned off. The humidifier was disconnected soon after its installation, because it tended to spit water over historic furnishings.¹⁴⁵

The first comprehensive on-site Park Service staff inspection of the main house and annex commenced during the winter of 1979-80. A second series of building conditions inspections

142. *Ibid.*

143. *Ibid.*, and Memorandum, Historic Architect, WRO to Chief, Williamsport Preservation Center, NPS, January 31, 1984, Administrative Files Collection.

144. Patrick Calhoun to Bob Cox, Historic Architect, WRO, August 10, 1977, and Notes, Telephone Call, Patrick Calhoun to Historic Architect, September 15, 1977, Administrative Files Collection.

145. Howard Chapman, Regional Director, WRO to Dr. Knox Mellon, California State Historic Preservation Officer, Scotty's Castle XXX Request, October 28, 1977; Memorandum, Bob Cox to Del Galloway, May 5, 1978; Memorandum, Jack Fields to WRO, June 19, 1978; "Diary of Work, Death Valley Scotty's Castle Jasper Fountain," April 25-27, 1978; WRO Historic Architect to Chief, WRO Cultural Resources, May 11, 1978; Memorandum, Historic Architect to Chief, Cultural Resource Management, WRO, September 21, 1981; Administrative Files Collection; and data gathered by James O'Barr during conversation with John May, January 1990, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

during the following summer led to discovery of major cracks in several trusses in the great hall. Maurice Paul, a Park Service structural engineer with the Denver Service Center, was called in to inspect the cracks. Determining that the cracks were significant, Paul recommended a large-scale effort to preserve the stability of the structure. The great hall was closed to visitors, and scaffolding was installed. Beginning in 1981 an elaborate support system of tension bars and through bolts was devised for the affected trusses.¹⁴⁶

As early as 1973 a review of castle utility systems by Beamer, Wilkinson and Associates had recommended major overhaul of the electrical system. The first Park Service review of the electrical system, however, did not occur until August 1978 under the direction of the Denver Service Center. In March 1981 Ray Johanningsmeier, an electrical engineer with the Denver Service Center, inspected the castle electrical system and made recommendations for its improvement. With his technical support and the use of his drawings, Park Service personnel at the castle completed some 95 percent of the rewiring by September 1981.

Fire detection and security systems were also installed in the main house and annex during 1981-82. A security system was developed for the castle by an outside contractor and installed by park staff in conjunction with the electrical rewiring project. The system included cameras and smoke and intrusion detectors throughout the main house and annex and a monitoring system in the annex or patio apartment. Improvements were made to the water reservoir, springhouse and chlorination system, and a new water supply loop for exterior fire protection with hydrants and hose houses was installed under contract in 1982, the final inspection taking place in November 1982.¹⁴⁷

Throughout the 1980s various other repairs and improvements were made to the main house and annex. These include:

1. A wheelchair lift was attached to the outside north stairway of the main house in January 1980.¹⁴⁸
2. A photographic darkroom was installed in the basement in 1981.¹⁴⁹
3. In November 1982 loose ceiling stucco was removed from the annex garage.¹⁵⁰

146. Memorandum, Unit Manager, Scotty's Castle to Historic Architect, WRO, July 22, 1980, and Maurice Paul to Assistant Manager, Western Team, Denver Service Center, October 29, 1980, Administrative Files Collection.

147. Roy Richardson, Electrical Engineer, Denver Service Center to Assistant Manager, Western Team, Denver Service Center, August 14, 1978; Memorandum, Historical Architect, WRO to Unit Manager, Scotty's Castle, January 15, 1981; Acting Chief, Denver Park Support Office to Regional Director, WRO, March 23, 1981; Superintendent, DEVA to Chief, Western Archeological Conservation Center, June 5, 1981; Scotty's Castle Input Meeting Notes, September 1981, November 1982; Administrative Files Collection.

148. Data gathered by James O'Barr during conversation with Jack Fields, January 1990, in O'Barr, "Notes On the Maintenance of Scotty's Castle," n.p.

149. Data gathered by James O'Barr during conversation with George Voyta and John May, January 1990, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

150. *Ibid.*

4. In December 1982 miscellaneous drainage problems between the powerhouse and the west end of the castle complex were studied and partially corrected.¹⁵¹
5. A propane gas farm was installed above the stables in 1983 to replace the scattered units used to supply gas several buildings.¹⁵²
6. During 1983 a loft was built in the back room of the organ pipe chambers to store the former organ system. Schoenstein and Company replaced the old system with new solid state circuitry and relays and installed a digital recorder so that tunes could be encoded and reproduced precisely as an organist played the instrument or as the Welte roll player performed.¹⁵³
7. In January 1984 boards in the dining room ceiling were removed for inspection.¹⁵⁴
8. To help control the moisture in the buildings, humidifiers and de-humidifiers were placed throughout the main house and annex in 1985.¹⁵⁵
9. Rubber treads were installed on the stairway in the great hall during 1985 to provide greater traction for visitors.¹⁵⁶
10. A lock was installed on the outside door of the basement "seahorse room" in 1985.¹⁵⁷
11. Lines for cable television and telephone systems were laid in 1986.¹⁵⁸
12. During the past several years the Park Service has been bushing door hinges with plastic washers that may be replaced occasionally, thus saving wear on the historic metal hinges.¹⁵⁹
13. In 1988 restoration of the annex lanai was commenced.¹⁶⁰

151. *Ibid.*, and Scotty's Castle Staff Meeting Notes, December 1982, Administrative Files Collection.

152. Data gathered by James O'Barr during conversation with George Voyta and John May, January 1990, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

153. Museum Catalog Folder DEVA 14006, Administrative Files Collection.

154. XXX Files, Administrative Files Collection.

155. *Ibid.*

156. *Ibid.*

157. *Ibid.*

158. Data gathered by James O'Barr during conversation with George Voyta and John May, January 1990, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

159. Data gathered by James O'Barr during conversation with Don Creech, December 1989, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

160. Personal reminiscences, in O'Barr, "Notes on the Maintenance of Scotty's Castle," n.p.

14. The basement drain pipe for the kitchen sink in the main house was modified in 1988.¹⁶¹
15. The security system was overhauled in 1988 during which time the document storage area was integrated into the system.¹⁶²
16. The fire brick in the castle furnace was replaced in 1988.¹⁶³
17. Work was commenced during the summer of 1989 to install conduit pipe in the tunnels to drain water that had formerly been channeled through open watercourses. The water in the newly installed pipes was diverted into the main water drain which empties into the lake at the gatehouse. The purpose of the work was to control pest populations in the main house and annex.¹⁶⁴
18. The hydrant on the southeast corner of the annex burst during the winter of 1989-90 and required replacement.¹⁶⁵
19. Three steam line failures occurred in the main house in December 1990, the most serious being a leak below the radiator in Mr. Johnson's bedroom which caused damage to the east kitchen wall below.¹⁶⁶

161. *Ibid.*

162. *Ibid.*

163. *Ibid.*

164. *Ibid.*

165. *Ibid.*

166. Data provided by George Voyta, March 1991.

APPENDIXES

HISTORY

APPENDIX A, BIOGRAPHIES OF SIGNIFICANT INDIVIDUALS ASSOCIATED WITH DEATH VALLEY RANCH

ALBERT MUSSEY JOHNSON (1872-1948)

Albert Mussey Johnson was born May 31, 1872, into a wealthy Quaker family in Oberlin, Ohio. Albert H. Johnson, Albert's father, was a wealthy banker and financier with investments in railroads and quarries.

After finishing school in Oberlin, Johnson entered Cornell University in 1892 and earned a degree in civil engineering. While there he met and became engaged to Bessie Morris Penniman, who had transferred from Stanford. The two were married on November 19, 1896, at Bessie's girlhood home, Shadelands Ranch, near Concord, California.¹

The newly married couple moved into a small home of their own not far from Oberlin, where Albert began work with the Platform Binder Company. Later that same year Albert borrowed \$40,000 from his father to invest in mining operations in Joplin, Missouri, an area then undergoing an economic boom due to the discovery of zinc. Within a year Albert had received a 500% return on his investment.²

During 1897-98 Albert was secretary and manager of the Mussey Stone Company, a firm partially owned by his father.³ In December 1899, Albert and his father traveled through Utah and Colorado inspecting the potential of several possible enterprises, principally those related to mining and power generation. During their journey, the two men were involved in a train accident. The elder Johnson died instantly, while Albert suffered a severely broken back. For the next eighteen months Albert was bedridden, and some doctors feared that he would not live past his fortieth birthday.⁴

Although he would ultimately live well past the age of forty, the accident left him with a chronic medical condition for the rest of his life. He walked slightly stooped with a noticeable limp due to a baseball-sized callous that developed towards the base of his back. The injury motivated him to have furniture custom-designed to be more comfortable and to wear clothing that was slightly oversized so that his callous would not show. One account mentions that he even had some bathroom fixtures specially designed to accommodate his back.⁵

The injury also affected his career. Because of the effects of his injury the rugged travel necessary to inspect mining operations had to be restricted. Instead, Johnson focused his professional efforts on the world of investment finance. After a one-year period as vice-president of the Arkansas Midland Railroad, Johnson, together with E.A. Shedd, a former partner of Albert's

1. "Bessie Johnson," Vertical Files.

2. Johnston, *Death Valley Scotty*, p. 91; Levering Cartwright, "A Sacrifice to Death Valley," filed under "Albert Johnson" in Vertical Files.

3. Albert Nelson Marquis, ed., *Who's Who in Chicago* (Chicago: A.N. Marquis Publishing Co., 1926), pp. 460-61.

4. Cartwright, "A Sacrifice to Death Valley."

5. *Ibid.*

father, purchased the National Life Insurance Company and installed Johnson as its treasurer. By 1906 Johnson was the president of the North American Cold Storage Company. The latter was a warehouse operation that bought and sold commodities, primarily butter and eggs.

In November 1916, Johnson moved to a new home. Built at a cost of \$600,000 for Albert C. Wheeler, this marble mansion sat on the shore of Lake Michigan.⁶ Both Johnson and his wife were intensely religious, adhering to a strict fundamentalism. Neither of them drank, smoked, played cards, or attended the theater.

In 1904, Walter Scott was in Chicago seeking backers for his legendary gold mines, and E.A. Shedd and Albert Johnson invested. Despite receiving no return on his investment, and even after the person he sent to the desert to check on Scott reported that there was no gold mine, Johnson continued to invest in Scott's ventures. In 1909, Johnson himself went to California. Although he found nothing in the way of gold mines, the dry weather and outdoor life proved beneficial to his health.⁷ Johnson made repeated trips to visit Scott in the desert and by the time he realized that there was no gold mine, he had started to acquire land. Of the 1,500 acres he eventually owned, the Steininger Ranch was the most important parcel. Nestled in a spring-fed verdant valley, this was soon to be the site of the Death Valley Ranch.

Johnson's business interests prospered in the 1920s, as reflected in the construction activity at the ranch. In the 1930s Johnson's fortune declined, although he was never a poor man. He moved from Chicago to Los Angeles and spent more time at the ranch. At his death in 1948, he willed most of his fortune and property to the Gospel Foundation, an organization he had founded in 1946.

WALTER SCOTT (1872-1954)

Walter Scott was the youngest of six children. He was born in Cynthia, Kentucky, in 1872 and raised on a horse farm. At age eleven he ran off to Nevada to join his two older brothers, Warner and Bill. His first job after arriving by train was as a water boy for a survey party along the California-Nevada state line, part of which ran close to Death Valley. When the survey was completed Scott found work with the Harmony Borax Works in the valley. Scott was an accomplished horseman and eventually was engaged as one of the rough-riders for the Buffalo Bill Wild West Show. Although his engagement with the show lasted for twelve years, it was only seasonal employment. When not fully engaged with the show Scott would return to Death Valley and pick up odd jobs. His connection with the area became so well known that eventually Death Valley became his nickname.

Scott left the show after a disagreement with Buffalo Bill in 1902. His relationship with Johnson commenced soon thereafter. While Scott traveled frequently, he was regarded as a permanent resident of the castle. Nevertheless, it is evident that his participation in the project was far from direct.⁸

6. Johnston, *Death Valley Scotty*, p. 103.

7. *Ibid.*, p. 96.

8. *Ibid.*, passim.

For various reasons Johnson felt beneficent towards Scott, and in his will made specific provisions allowing Scott the right to live out the rest of his life at the castle. Scott died in 1954.

BESSIE JOHNSON (1872-1943)

Bessie Morris Penniman was born in what is now Walnut Creek, California, and raised on her father's fruit and nut ranch, Shadelands. She was one of the 150 freshmen that made up the first entering class of Stanford University in Palo Alto, California, in 1892. After two years of study she transferred to Cornell University in Ithaca, New York, where she met and eventually married Albert Mussey Johnson.

In 1915 Bessie underwent a religious conversion at a revival meeting conducted by the evangelist Paul Rader. Bessie later introduced her husband to Rader, which in turn led to Albert's full-fledged support for the minister. Bessie's religious fervor was given full vent at the ranch, where she conducted services and gave sermons every Sunday she was there for the white workmen.⁹

In Chicago, Bessie was deeply involved in the Chicago Business Women's Alliance. The alliance provided social services for single working women, to which Paul Rader was a frequent guest. In 1943, Bessie was killed in an automobile accident at Towne Pass, some forty miles south of the castle.¹⁰

CHARLES ALEXANDER MACNEILLEDGE

Very little of the architect's personal history is known. Charles Alexander MacNeilledge was born and schooled in Canada. There is no evidence that he was ever trained in or practiced interior or architectural design before coming to the United States. He established a studio and furnishings store in New York before relocating to Chicago and doing the same there. This is probably where Johnson and MacNeilledge met, for in 1921 Johnson hired MacNeilledge to redesign the library in his newly purchased Sheridan Avenue home on Lake Michigan.¹¹

Johnson must have approved of the results. In June 1926 he hired MacNeilledge to redesign the main building at his Death Valley Ranch complex. Up until the point when all construction ceased, new plans were continually being developed for remodeling other structures and adding several more.

It was not long after the original agreement that MacNeilledge moved his studio to Los Angeles, apparently to be closer to the ranch and its many operations. Plans for the ranch continually escalated. In June 1927 MacNeilledge agreed to become Johnson's personal employee and accepted a monthly salary that amounted to just over \$10,000 a year. All expenses for office, studio, and drafting assistants were paid by Johnson. In July 1927 two new draftsmen were

9. Historical brochure produced at Shadelands. A copy is on file in the vertical files under "Bessie Johnson."

10. See introduction to the soon-to-be-released 1987 reprint of *Death Valley Scotty by Mabel* written by Susan Buchel and published by the Death Valley Natural History Association.

11. Interview of Mrs. Fred Ford by Wayne Schultz and Dorothy Shally, March 5, 1979, n.p.

hired, probably because of the increasing workload resulting from the additional structures Johnson wished designed and built.

All costs incurred by MacNeilledge in the procurement of materials or furnishings were to be reimbursed by Johnson. MacNeilledge's payment included a ten percent override as a commission. This basic arrangement remained in effect for the remainder of their working relationship. It seems MacNeilledge took advantage of Johnson's largesse regularly and made it a frequent practice to ask suppliers to pay him directly 10-15% of the business he placed with them.

Johnson was first informed of this with a letter from the Blue Diamond Company, a supplier of raw building materials in Los Angeles, California. Johnson then directed Burton P. Sears, an attorney on staff with the National Life Insurance Company, to research the legal parameters of the architect-client relationship. Sears produced a seven-page document summarizing legal cases that pertained to the issue. Sears' final conclusion was that Johnson had no legal recourse to recover his money or prevent this from happening in the future.¹²

This disclosure probably resulted in Johnson's decision to renegotiate the financial agreement established between him and MacNeilledge. Why Johnson did not fire him and find someone else is difficult to explain. Perhaps Johnson admired MacNeilledge's work, or perhaps Johnson enjoyed him enough personally to endure such a situation. For whatever reason, Johnson was willing to bear the expense of having a "cheat" on his payroll.

While under salary to Johnson, MacNeilledge also redesigned the interiors of the executive offices of Johnson's National Life Insurance Company Building at 29 La Salle Street in Chicago. In addition, MacNeilledge designed a "Clubhouse" for Johnson's Burlington, North Carolina, rayon factory. The clubhouse structure was meant as a recreational facility for the executives and employees of the rayon plant Johnson began constructing in 1928. The structure was designed in the Colonial Revival style and still stands today. It is the only architectural design by MacNeilledge, other than the castle itself, known to exist. Other than the ranch and the clubhouse, all of his designs were exclusively for interiors.

It seems MacNeilledge's dishonest practices continued well beyond Johnson's first discovery. According to Martin de Dubovay, one of MacNeilledge's employees, MacNeilledge constantly double- and triple-billed Johnson for items MacNeilledge purchased. Dubovay also claims that the final straw came when MacNeilledge began forging checks using Johnson's name. MacNeilledge was summoned by Johnson to the ranch by telegram in the winter of 1931, and by February 1931 MacNeilledge was no longer working on the project. Perhaps, his deceitful behavior, combined with his constantly falling behind schedule in delivering his designs, in particular for the swimming pool, precipitated his dismissal. Afterwards, Dubovay was installed as the architect in charge for the last months of the final construction season.¹³

12. M.R. Filkins, Assistant to the President, Blue Diamond Company, Los Angeles, California, to Albert M. Johnson, May 24, 1927, Manuscript 7, Box 4, and Memorandum, Burton P. Sears to Albert M. Johnson, June 2, 1927, Manuscript 5, Box 1.

13. Interview of Martin de Dubovay by F. Ross Holland, June 1972, pp. 10, 27, and Albert M. Johnson to M. Roy Thompson, February 26, 1931, Manuscript 12, Box 4.

DESIGNERS AND DRAFTSMEN

Of the draftsmen MacNeilledge hired during the course of the ranch's design, the names of four are known. The first is William V.A. Hansen. Many of the earliest drawings of the main house bear his name as the delineator. Hansen was married to Alfred MacArthur's daughter Georgianna. MacArthur, a close friend and associate of Johnson's, was also a close friend of Frank Lloyd Wright and was probably responsible for introducing the two. MacArthur was a strong proponent of Wright's and probably counseled Johnson to investigate Wright as an architect for his new home and possibly a new office building in Chicago. It seems probable that MacArthur's influence with Johnson led to Hansen's being hired by MacNeilledge. It is equally possible that Hansen was involved in the building of MacArthur's home in Libertyville, Illinois, north of Chicago, also built in the Spanish Style. MacArthur's home was one that Johnson had visited and with which he had been greatly impressed. Hansen's regular employment probably did not continue much past the first year. He was rehired, however, for a three-week period in July 1928, indicating some form of continuing relationship with the project.¹⁴

Two draftsmen, Robert DeWitt and R.W. MacDonald, were hired in July 1927. The latter worked for two and a half weeks and was paid \$150. The former was employed for five weeks and received \$375 in compensation.¹⁵

Already mentioned is Martin de Dubovay. Dubovay was trained as an architect in Hungary and emigrated to the United States. After re-establishing himself professionally in Los Angeles he met Johnson by chance at a book store. Johnson noticed Dubovay because of his European accent and because he was carrying some architectural drawings. Johnson approached Dubovay and began explaining his project in the desert. Ultimately, Dubovay was put on the payroll in 1928 for the remaining years of construction. According to Dubovay, he was responsible for the design of the powerhouse and chimes tower (particularly the Medieval elements), much of the furniture, and for some of the metalwork at the castle. Although his influence was probably strongly felt, it seems that this is an exaggerated account of what actually took place.

At least one independent interior decorator, T.R. Davidson of Los Angeles, was sub-contracted for design work in November 1930.¹⁶ Other designers and draftsmen probably worked on designing the castle. Other than Dubovay, it does not seem as though they were retained for a regular length of time, but rather when the need for production was great.

14. Charles Alexander MacNeilledge to Albert M. Johnson, July 27, 1928, Manuscript 5, Box 2.

15. Charles Alexander MacNeilledge to Miss Devlin, August 5, 1927, Manuscript 5, Box 1.

16. See invoice, November 3, 1930, printed in U.S. Department of the Interior, National Park Service, *Scotty's Castle Furnishings, Death Valley National Monument, California*, by Katherine B. Menz, 1979, p. 15. (Draft)

FREDERICK WILLIAM KROPF (?-1941)

Frederick William Kropf was the construction superintendent or foreman at Death Valley Ranch from September or October 1922 until June 1924 and supervised the construction of the first three buildings.

Kropf was trained as a carpenter and moved with his two children from Provo, Utah, to Los Angeles, California, in 1916. His wife had died in 1911. In 1918 Kropf was hired by L.L. Nunn to direct the construction of Deep Springs College, a boys' preparatory school seventy miles northwest of Death Valley Ranch. Kropf had previously worked for Nunn in Provo, Utah, in connection with the electrical generating stations Nunn had established.

Both Nunn and Johnson had grown up in Oberlin, Ohio, and had remained friends throughout the years. In 1917, Nunn and Johnson were touring by car when Nunn spied Deep Springs Canyon for the first time and decided to establish a school there. In those early years, Johnson often stopped at the school on the way to his ranch to have a meal, spend the night, or sometimes deliver a sermon. In return, the boys were always welcomed as visitors to the castle. The school still exists and has a large collection of photographs taken during Johnson's visits to the college and the many field trips by the boys to the castle.

Milton, Kropf's son, remembers that Johnson often conferred with Kropf about the plans for his own place and generally sought Kropf's advice. In September or October 1922 Johnson hired Kropf and his son to work at the ranch. Several months later Johnson hired Kropf's daughter, Melba, as the camp cook.

Melba was fired in April 1924 because of a disagreement she had with Bessie. Kropf was let go three months later. Milton recalls how his father had interrupted Bessie during one of her sermons, and believes that might have been the cause for his dismissal. Another possibility is that Johnson had completed the first phase of work and no longer needed Kropf's services.¹⁷

M(ATT) ROY THOMPSON (1874-1962)

In October 1925 Thompson moved to Grapevine Canyon and assumed his duties as general superintendent for construction at Death Valley Ranch. He remained in that position until August 1931, several months beyond the point when all construction at the ranch ceased.

M. Roy Thompson¹⁸ was born in Dunlap, Iowa, in 1874. Matt's father, George Washington Thompson, moved with his family to Tacoma, Washington, in 1887. Matt's father dealt in real estate, became owner of a nearby electric railroad, and eventually the president of the local Chamber of Commerce. At age 16 Matt graduated high school and enrolled in Rose Polytechnic Institute in Terre Haute, Indiana, to study civil engineering. In October 1891, Thompson

17. Interview of Milton Kropf by Steven Harrison, January 21, 1980, n.p., and Interview of Melba Kropf Ford by Steven Harrison, January 21, 1980, n.p.

18. Thompson was originally christened Leroy. His uncle Matt thought it proper that he, like most every one else at that time, have three names, and Leroy took the name Matt, but usually signed everything as M. Roy Thompson. He made the name change legal when it became necessary to apply for work with the military during the Second World War.

transferred to Stanford and was one of only fifteen sophomore students in the university's first entering class. The remainder were freshmen. While there he met and dated Bessie Penniman Morris.

Thompson's family lost its money during the Panic of 1893, and Matt was forced to leave school. He returned to Tacoma and was hired as an assistant engineer to help construct the Bremerton Drydock. Soon afterwards he became an assistant to E.O. Schwaegerl, a landscape architect, in laying out Point Defiance and Wright parks.¹⁹

In 1897 Thompson was engaged as an assistant engineer for the state of Washington. Four years later he took the position as Chief Right-Of-Way Engineer for the Northern Pacific Railroad with a territory that included the four northwestern states.²⁰ Bessie had left Stanford close to the time that Matt did and transferred to Cornell University, where she met and eventually married Albert Mussey Johnson. In 1904, the Johnsons, en route to Alaska, stopped in Tacoma to visit Matt and his new wife, Patience. It was then that Matt and Albert met for the first time.

In 1907 Matt was engaged by Major Edward Bowes, of radio fame, to design and lay out two land developments Bowes was financing. The first project was Regents Park, just outside Tacoma. Matt, in conjunction with his brother Paul, oversaw the grading of four miles of roads, construction of concrete sidewalks, and installation of a water and sewer system.²¹ Matt and Paul went on to do much the same for the Thousand Oaks subdivision in Berkeley, California.

With his land development work completed, Matt accepted a position with the Washington State Highway Department. There he designed and maintained many of the roads in Mount Rainier National Park.²² Two years later Thompson was elected county engineer for Pierce County. During his two-year tenure forty miles of concrete road were constructed in the county. The use of concrete in road construction was still a novel technique and as county engineer he traveled throughout the country studying concrete roads.

In 1918 Roy became a member of the Interstate Commerce Commission's (ICC) Appraisal Board. His office was in Aurora, Illinois, and his duties consisted of estimating the value of the property owned by nine different railroads centered in Chicago. He was a frequent visitor of the Johnsons and attended the same Congregational Church.

In either late 1924 or early 1925 Johnson approached Thompson with his offer of employment as ranch superintendent and a \$400 monthly salary. Johnson must have realized that Thompson's background in laying out subdivisions, landscape design, and concrete construction would prove extremely useful for the plans Johnson was developing for the ranch. Of particular value would be Thompson's professional credentials in land survey and appraisal, for much of Johnson's land acquisition was from the public domain.

19. *Tacoma Times*, September 19, 1935, filed under "Matt Roy Thompson" in Vertical Files.

20. *Gettysburg Times*, July 27, 1956, and *Tacoma News Tribune*, September 19, 1935, filed under "Matt Roy Thompson" in Vertical Files.

21. *Tacoma News Tribune*, September 9, 1925, July 15, 1959, filed under "Matt Roy Thompson" in Vertical Files.

22. *Tacoma News Tribune*, September 19, 1935, filed under "Matt Roy Thompson" in Vertical Files.

After accompanying the Johnsons in their visit to the ranch in March 1924, Thompson responded favorably to the project and the role he was to play in it. He received a one-year leave of absence from the ICC. Thompson never expected that his involvement with Death Valley Ranch would last as long as it did, for he hoped to retain his civil service rating and return to work for the government within a year. This seems to indicate that Johnson had not formed any specific plans at this early stage and that no one had conceived of how long Thompson would stay on as superintendent or even how long construction would continue.

When construction at the ranch ceased in August 1931, Thompson, like the rest of the work force, was presumably let go. Thompson found new employment for the next three years as senior land appraiser for the Metropolitan Water District in California while the Los Angeles Colorado River Aqueduct was being constructed.

In 1940 Johnson hired Thompson to survey some land in Santa Maria, California. Ownership of the land was in dispute. While in Johnson's employ, Thompson traveled to the site to check on the title. Expense records for the trip and some related correspondence are on file in the library at Scotty's Castle.

Other accomplishments by Thompson include the laying out of the Mojave Air Base for the engineering firm of Kisner, Curtis and Wright in 1942. He also laid out the Roosevelt Base on Terminal Island in San Francisco Bay for the firm of Holmes and Narver of Los Angeles, California.²³

In 1947 Johnson contacted Thompson in connection with the completion of the swimming pool at Death Valley Ranch. Thompson was due to leave for Japan to oversee a nuclear test for Holmes and Narver and planned to meet with Johnson upon his return. Johnson, who was very ill and confined to his Hollywood home at the time, died the following January before plans for finishing the pool could be completed.

23. *Desert Magazine*, September 1952, filed under "Matt Roy Thompson" in Vertical Files.

APPENDIX B, LIST OF FIRMS SUPPLYING CONSTRUCTION MATERIALS FOR DEATH VALLEY RANCH

The Death Valley Ranch project extended over a ten-year period and resulted in more than a dozen buildings and projects. It would be difficult to pinpoint which supplier furnished which material for which building. Instead a list of suppliers and the materials they furnished is presented here. It should be considered a partial list, as it was derived only from those that were recorded in Manuscripts 7 and 15 of the archives at Scotty's Castle. Other sources probably exist, but would not be as rich or specific in their information.

CEMENT

Blue Diamond Company, Los Angeles, California
Colorado Portland Cement Company, Denver, Colorado
Riverside Cement Company, Los Angeles, California
Sawyer-Hassett Company, Los Angeles, California
Union-Portland Cement Company, Ogden, Utah
Utah Sales Company, Ogden, Utah

CONSTRUCTION MACHINERY

Construction Machinery Company, Los Angeles, California
B. Hayman Company Incorporated, Los Angeles, California
Frank T. Hickey, Los Angeles, California
Smith-Booth-Usher Company, Los Angeles, California

DOORS AND MILLWORK

Pacific Door and Sash Company, Los Angeles, California
W.H. Sheidenberger & Sons, Los Angeles, California

DOOR AND WINDOW HARDWARE

Sargent and Company, Chicago, Illinois

FENCING

Harry Baylies, Los Angeles, California

HARDWARE AND TOOLS

Union Hardware and Metal Company, Los Angeles, California

GENERAL BUILDING SUPPLIES

Crane Company, Los Angeles, California

INSULEX

Pacific Portland Cement Company, Consolidated, Los Angeles, California
Sawyer-Hassett Company, Los Angeles, California

IRON PIPING

Martin Iron Works, Los Angeles, California

LANDSCAPE MATERIALS

Armstrong Nurseries, Ontario, California
Beverly Hills Nurseries, Beverly Hills, California
Phyllo Cactus Farm, Hollywood, California
Theodore Payne, Los Angeles, California
San Fernando Nursery Company, San Fernando, California
San Pedro Ranch Nursery Company, Compton, California
Roy R. Wilcox & Co., Montebello, California

LUMBER

E.K. Wood Lumber Co., Los Angeles, California
Hammond Lumber Company, Los Angeles, California
Woodhead Lumber Co., Los Angeles, California

METAL LATH

Blue Diamond Co., Los Angeles, California

METAL WORK

Artistic Iron Works, Pasadena, California
Aztec Forged Hardware Company, Los Angeles, California
Julius Dietzmann's Ironcraft Works, Los Angeles, California
Earle Hardware Mfg. Company, Los Angeles, California

Western Metalcrafts, Los Angeles, California

OFFICE EQUIPMENT

Charles Bruning Co., Inc., Los Angeles, California

PAINTS AND STAINS

Los Angeles Chemical Company, Los Angeles, California

Martin-Senour Company, Los Angeles, California

Oakley Paint Manufacturing Company, Los Angeles, California

W.P. Fuller & Co., Los Angeles, California

PLATE GLASS

The Dixon Glass Company, Los Angeles, California

IRON PIPING

A.M. Byers, San Francisco, California

REINFORCEMENT STEEL

American System of Reinforcing (later Soule Steel Co.), Los Angeles, California

Blue Diamond Co., Los Angeles, California

Union Hardware and Metal Co., Los Angeles, California

ROOFING ASPHALT AND CONCRETE PRIMER

Johns-Manville, Los Angeles, California

STEEL WINDOW SASHES

Detroit Steel Products Co., Detroit, Michigan

Fenestra Construction Company, Detroit, Michigan

STUCCO

Blue Diamond Co., Los Angeles, California
California Stucco Products, Los Angeles, California
Sawyer-Hassett Co., Los Angeles, California

TILE

Alhambra Kilns, Alhambra, California
Hispano-Moresque, Los Angeles, California
Gladding-McBean, Los Angeles, California
E.M. Rodriguez, Los Angeles, California
The Spanish Pottery, Los Angeles, California

VITRIFIED SEWER PIPING

Pacific Clay Products, Los Angeles, California

APPENDIX C, DESCRIPTION OF EXISTING CONDITIONS OF MAIN HOUSE / ANNEX

GENERAL STATEMENT

Architectural Character

The main house/annex is actually two separate parallel structures connected at the center by a second-story footbridge. A tiled open courtyard defined by round-arched gates to the east and west lies between the two structures, and establishes the main axis for this and for much of the complex. The main house accommodated most of the Johnsons' private domestic functions. The annex contained guest bedrooms and a music room with a large organ on the second floor, and some storerooms, a laundry room, a walk-in refrigerator, a garage, an office for Mr. Johnson, and a sitting room and kitchen for Mrs. Johnson on the first.

Condition of Fabric

Good except for specific situations, such as the exterior stuccoing, which is separating from the walls in several isolated locations and is in need of repair.

DESCRIPTION OF EXTERIOR

Overall Dimensions

Main House. 97' x 33'.

Annex. 112' x 26'.

Foundations

A small portion of the foundation is made of brick. This part probably survived from the original structure. The remainder is reinforced concrete.

Wall Construction, Finish, Color

Main House. Wood-frame construction with a brown and beige stucco exterior finish.

Annex. The first floor is reinforced concrete and the second floor is wood-frame construction. Both floors have a brown and beige stucco exterior finish.

Structural System, Framing

Main House. Wood-frame construction.

Annex. First story is reinforced concrete. Second story is wood-frame construction.

Porches

Main House. A large entry portico, with three round arches, contains a spacious landing in front of the main entrance to the south. The landing's concrete railings are formed in a "weave-like" pattern, unique to the ranch.

A shed-roofed lanai is supported just above. The wooden roof is supported by "s" shaped metal brackets to the south and by wooden pilasters with fluting where the roof meets the house to the north. Both the lanai and the landing have floors of red tile.

Annex. The annex features a lanai on its south side. Instead of projecting from the main mass, like the other, it is recessed and enclosed within a wood framework and mesh screening. The floor and walls are decorated with colored tiles, and a fountain with ceramic frogs at the four cardinal points occupies the center of the space.

Chimneys

The main house has three chimneys and the annex has two. Each is individually designed and distinct from the other. Two of other chimneys of the main house have a plain gray stucco finish, scored to simulate ashlar masonry. The remaining three have a brown and beige stucco exterior, two of which have colored-tile caps.

Openings

Doorways and Doors. Most of the doors are made of redwood boards joined by tongue-and-groove construction and decorative hand-forged metal strap hinges. The hinges have various designs reminiscent of the desert (i.e. grapevines, cacti). The wood has been seared with a blowtorch to darken the wood and accentuate its grain. Several doors have large redwood lintels. The main entries (north and south) to the main house have "DEATH VALLEY RANCH" engraved in the lintels, and sidelights with carved spindles and decorative metal bosses.

Windows. Most of the windows are operable and have multiple or single lights in metal sashes. Almost all have large redwood lintels and redwood shutters. Some have protective metal grilles on the outside of the structure.

Roof

Shape, Covering. Red-tiled gable roofs. The main house has three different sections, each roofed at a different height. The annex also has a variety of roof levels.

Cornice, Eaves. Most of the roof rafters are exposed and have been darkened and decoratively carved. The gables of the annex have been trimmed with two offset rows of wood scalloping.

The annex has a double row of wooden scalloping around almost the entire structure. This particular feature is absent from the main house.

Towers

The main house/annex has three separate towers, two of which are in the annex. The largest tower, located at the northeast corner of the annex, houses a large circular stairway that leads first to the music room and is generally referred to as the music room tower. The stairway ultimately leads to a third-floor observation platform and balcony. The platform is surrounded by large round arches infilled with concrete grillwork. The balcony, supported by arched corbeling, features a solid concrete railing with quatrefoil cutouts. The flat roof is concealed behind a parapet wall with exaggerated battlements. A flag flies from a pole mounted at its center.

The annex has a second smaller tower at the point where it meets the footbridge and basically serves as an open-air foyer. The flattened conical roof is covered with red tiles and has a custom-designed weather vane, representing a desert prospector cooking his meal over an open fire, mounted at its center.

A third tower, known as the observation tower, is situated within the main house just east of the living hall. This tower features an observation area, from which it derives its name, an electric light, and a pigeon loft trimmed with decorative tile. The flattened conical roof is covered with red tiles and has a custom-designed weather vane, representing the prospector leading his burro across the desert, mounted at its center.

Decorative Features

The gates have carved animal figures at the top of each of the four posts.

The south side of the annex has a sun dial made of tile. The profile of the god Janus is featured.

The east gate has two concrete medallions affixed to the wall. Martin de Dubovay claims he designed these to represent the ancient animals of the region.

The east side of the music room has two large wooden shutters. Each leaf features a decorative cut-out representative of a potted pomegranate.

DESCRIPTION OF INTERIOR

Stairways

Living Hall. Both the first flight of stairs, leading to the encircling gallery, and the second flight of stairs, leading to the observation tower, have straight runs alongside the hall's east wall. The first flight has a tiled stairway and metal hand railing. The second flight is much narrower and has a metal stairway and a metal hand railing.

The exterior stairway, north of the main house, has a tiled stairway and a concrete hand railing capped with red tile.

The circular stairway within the music room tower has concrete steps that cantilever from the inside wall of the tower and features a metal hand railing. The last twelve steps to the observation platform are completely metal and in a straight run.

Flooring. Almost all floors are laid with tile. The gallery surrounding the second story of the living hall has hexagonally shaped tile, some of which have colored heraldic imprints and colored borders. Most of the floors have custom-designed Majorcan rugs as a covering.

Wall and Ceiling Finish. Several different stucco finish textures were devised by MacNeilledge. Those are basically beige in color and have a coarse-finished texture, varying in their degree of roughness and color.

The ceilings of most of the rooms are slightly tented. Some, like the living hall, the music room, the solarium, and the main guest room, have open ceilings that reveal the decoratively carved wood beams and trusses. Most follow a similar rusticated style. The music room, however, has a strong ecclesiastical flavor and includes acoustic paneling between the ornately carved beams. Representations of the desert holly and the pomegranate, the national flower of Spain, have been carved into the cross-beams of the octagonally shaped solarium.

Most of the other rooms are simply sheathed in wood and not as intricately detailed. Two rooms, the lower music room and the dining room, have Spanish inscriptions carved along the base of the ceiling.

Almost all of the remainder, particularly those of the first floor of the annex, are plastered and finished in the same style as the walls. The kitchen of the main house has a series of plastered barrel arches trimmed by wood strips.

Windows and Trim. The gallery, lower music room, and Scotty's room have interior shutters that are decoratively pierced. Those in Scotty's room have cutouts in the shapes of mountain lions, mountain goats, and horses.

Almost all the windows in the main house and second floor of the annex have decorative hand-forged curtain rods. The floor-length windows of the solarium have colored tile surrounds.

The west side of the music room has a round colored glass window. The other windows and French doors of the music room have a plaster surround that simulates stippled ashlar voussoirs.

Lighting Fixtures. The living hall has a large chandelier. Scotty's room has lizard-shaped wall fixtures. The main kitchen and music room have snake-shaped wall fixtures. The music room also has four triple-tiered chandeliers.

Decorative Features

The living hall has a jasper rock fountain with a tiled pool at its base. No longer functioning, the water was meant to trickle down slowly from above. The water evaporation cooled the room,

and the sound had a soothing effect. Directly across from the fountain is a large fireplace, plastered to simulate ashlar masonry. The firebox features dragon-shaped andirons.

The solarium has a smaller but similar type fountain that also no longer functions. This fountain is made exclusively of tile that displays an underwater marine scene.

The lower music room has a rounded fireplace in the northwest corner. It is surrounded with colored tile and has glass photographs of Albert Johnson and Scotty imbedded in the mantle. They are illuminated from behind with an electric light.

The dining room has a full wall of hand-carved built-in shelves. They presently exhibit the Italian dinnerware purchased by MacNeilledge for the Johnsons during his trip to Europe in 1929.

The main kitchen has a tiled built-in sink and counter. The metal cabinet drawers below the sink have cut-out shapes representing the prospector and the burro crossing the desert. The axe, shovel, canteen, and initials J and S are also represented. To the south of the sink in the very corner is a false water well that in reality conceals a garbage can. The refrigerator is concealed within an elaborate wood framework, and a gas stove is contained within a large simulated hearth covered with tile.

The base of the music room ceiling has a series of 48 medieval shields set within a wood framework. The radiators in the music room are concealed by ceramic grilles. All the other radiators in the house are concealed by metal grillwork.

SITE

General Setting and Orientation

The main house and annex face south with their main axis oriented east to west. The monumental and unfinished swimming pool is directly in front. The annex is built into a steep bluff of solid rock. A large concrete retaining wall separates the bluff from the annex and creates a small space, meant to serve as a coal and service yard.

A large open space to the west between the main house and the powerhouse was the site of the unfinished west patio. Only some excavation and foundation work actually was executed.

The large entrance court to the east was once planted in palm trees. Plans were made, but never carried out, to pave the area and put in a watercourse. The concrete substructure of the wishing well was built. It was tiled in the 1950s, while the Gospel Foundation administered the ranch.

APPENDIX D, PHYSICAL HISTORY CHRONOLOGY OF MAIN HOUSE / ANNEX

DATE OF ERECTION

c. 1922 – Construction of the original main house structure began.

c. 1924 – Construction of the original main house structure was completed.

By end of 1926 – Construction of the "commissary" was completed.

June 1926 – The remodeling of the main house and annex began.

ARCHITECT

Albert Mussey Johnson probably designed the original main house and commissary structures. Charles Alexander MacNeilledge designed the extensive remodeling and additions.

ORIGINAL AND SUBSEQUENT OWNERS

Albert Mussey Johnson (c. 1922-1948)

Gospel Foundation (1948-1970)

National Park Service (1970-present)

BUILDER, ETC.

General superintendent –F.W. Kropf (c. 1922-1924)

M. Roy Thompson (1925-1931)

Building superintendent –F.X.A. Kreil (c. 1925-1927)

H.B. Brown (1927-1930)

C.G. Johnson (1930-1931)

W.D. McLean (1931)

ORIGINAL PLANS AND CONSTRUCTION

Plans for construction at Death Valley Ranch probably began as early as 1921. All the original design work for the main house was probably executed by Johnson, although he might have relied to a large extent on the advice of Frederick W. Kropf, his first construction superintendent.

An early framing plan entitled "Ranch House for A.M. Johnson" (41028c, 49/88) has unfortunately lost the corner of the sheet with its date, but is extremely similar in style to the framing plans for other early structures (e.g., Garage 41028c, 46/88) that are dated November 1922. The foundation plan for the "Ranch House of A.M. Johnson" is also dated November 1922 (41028c, 49/88). Although none of the above are signed, they were all probably prepared by Albert Johnson.

A subsidiary structure to the north and behind the main house was originally called the "Cellar in the Bank." Even before it was built the name for it changed to "Commissary" or "Commissary Building." By the end of 1926 the one-story reinforced concrete structure was completed and soon thereafter served as a storehouse for food and supplies and as a work space for construction. It also eventually housed the first electrical-generating "Power Room" at the ranch.

In June 1926 a professional designer, Charles Alexander MacNeilledge, was contracted to redesign the main house. The Spanish Mediterranean theme for the design was agreed upon and the main house was rebuilt.

A second story was then added to the commissary in two separate phases. The "Guest House" was built first over the west end and then the "Music Room" was built over the east end. A foot bridge was erected to join the second level of the commissary with that of the main house. Once these second-story additions were completed the entirety was referred to as the "Annex."

ALTERATIONS AND ADDITIONS

The exterior courtyard stairway on the north side of the main house has been modified for use as a motorized wheelchair ramp.

Portions of the basement below the main house have been partitioned with plywood walls to accommodate the storage of some of the more valuable furnishings, particularly rugs.

Mrs. Johnson's apartment, on the first floor of the west end of the annex, has been modified for use as employee housing.

The rooms in the basement below the solarium have been modified for use as a photographic darkroom and as the "Preservation Office" for the National Park Service. This office serves the administrative needs of the preservation maintenance staff.

APPENDIX E, PHYSICAL HISTORY CHRONOLOGY OF STRUCTURES AT DEATH VALLEY RANCH OTHER THAN MAIN HOUSE/ANNEX

(Extracted from HABS study.)

GUEST HOUSE / HACIENDA

Physical History

1. Date of Erection: 1927-31.

October 1927 - Excavation began.¹

December 1927 - Concrete footings were poured.²

January 1928 - Basement walls were poured.³

February 1928 - Basement slab roof was poured.⁴

March 1928 - Wood frame for the upper story was erected.⁵

April 1928 - Insulex was poured in the walls of the end porches.⁶

July 1928 - Carpenters worked on the wood trim.⁷

August 1928 - Interior tile was set.⁸

October 1928 - Exterior stucco finish was applied.⁹

November 1928 - Interior floor tile was set and the wiring was pulled.¹⁰

January 1929 - The tile on the porch was laid.¹¹

February 1929 - Exterior stairway in rear was poured. Sewer connection was completed. Concrete was poured for stairway to southwest corner of the basement.¹²

March 1929 - MacNeilledge laid out the lines for "the wall along the north edge of the road in front of the Guest House..."¹³

Plumbers installed water and gas pipes in the basement. Most of the electric light fixtures were installed.¹⁴

The new retaining wall west of the driveway was poured.¹⁵

May, 1929 - East portion of concrete walls was poured. Walls in front of Guest House were plastered and copped with tile.¹⁶

June, 1929 - The tile of the porch was laid.¹⁷

January, 1930 - Some interior tiling and plastering details were finished.¹⁸

May, 1930 - Plans by MacNeilledge for "Aztec Lounge" were completed and received at the Ranch.¹⁹

July, 1930 - New electrical plans were completed.²⁰

2. Architect: Charles Alexander MacNeilledge

3. Original and Subsequent Owners:

Albert Mussey Johnson (1927-1948)

Gospel Foundation (1948-1970)

National Park Service (1970-Present)

4. Builders, Manufacturers, etc:

General Superintendent: M. Roy Thompson

Building Superintendent: H.B. Brown (1926-1930)

C.G. Johnson (1930-1931)

Electric light fixtures: Julius Dietzmann's Forged Ironworks, Los Angeles, California.

Decorative tiles in bathroom and along fireplace: The Spanish Pottery, Los Angeles, California.

Iron grilles over basement windows: Western Metalcraft Co., Los Angeles, California.²¹

5. Original plans and construction:

Originally the upper story, which housed visitors and guests of the Johnsons and Scotty, had two separate but identical apartments with a shared kitchen centrally located on the north side.

Although never completed, the basement was to be divided with the east half devoted to coal storage and automobile garage and the west half to be an "Aztec-styled" lounge area. A letter from M. Roy Thompson to Albert Johnson says, "Mr. MacNeilledge has since indicated that this half of the basement is to be finished as a sort of Aztec lounging room."²² Only the walls and the ceiling of the two rooms farthest to the west and a bathroom were plastered and completely finished. The remainder of the walls have only a rough stucco finish. The rest of the ceiling has a layer of exposed metal lath.

6. Alterations and additions:

[Later the Nat. Park
rule]

While the Gospel Foundation owned the Ranch, they rented rooms at the Guest House to paying visitors. The Foundation probably adapted the fireplaces to accommodate gas heaters and boarded up the doorway from the shared kitchen to the west apartment. The Foundation used the kitchen as a bathroom. In 1979 the National Park Service soundproofed the door and in 1983 they added a kitchen range and some cabinetry to make this a separate and complete living area for employees.²³

In 1976 the National Park Service modernized the east half of the basement into a "Multi-Purpose Facility." This now includes recreational, cooking, meeting and first aid facilities.

1. Letter from M. Roy Thompson to Albert M. Johnson, dated October 17, 1927. Outgoing correspondence, manuscript 7, box 5.
2. Letter from M. Roy Thompson to Albert M. Johnson dated December 20, 1927. Outgoing correspondence, manuscript 7, box 5.
3. Letter from M. Roy Thompson to Albert M. Johnson dated January 29, 1928. Outgoing correspondence, manuscript 7, box 6.
4. Letter from M. Roy Thompson to Albert M. Johnson dated February 19, 1928. Outgoing correspondence, manuscript 7, box 6.
5. Letter from M. Roy Thompson to Albert M. Johnson dated March 11, 1928. Outgoing correspondence, manuscript 7, box 6.
6. Letter from M. Roy Thompson to Albert M. Johnson dated April 5, 1928. Outgoing correspondence, manuscript 7, box 6.
7. Letter from M. Roy Thompson to Albert M. Johnson dated July 7, 1928. Outgoing correspondence, manuscript 7, box 6.
8. Letters from M. Roy Thompson to Albert m. Johnson dated August 14 and August 28, 1928. Outgoing correspondence, manuscript 7, box 6.
9. Letter from M. Roy Thompson to Albert M. Johnson dated October 27, 1928. Outgoing correspondence, manuscript 7, box 7.
10. Letter from M. Roy Thompson to Albert M. Johnson dated November 7, 1928. Outgoing correspondence, manuscript 7, box 7.
11. Letter from M. Roy Thompson to Albert M. Johnson dated January 20, 1929. Outgoing correspondence, manuscript 7, box 7.
12. Letters from M. Roy Thompson to Albert M. Johnson dated February 3, February 15, February 19, February 26 and February 28, 1929. Outgoing correspondence, manuscript 7, box 7.
13. Letter from M. Roy Thompson to Albert M. Johnson dated March 3, 1929. Outgoing correspondence, manuscript 7, box 7.

14. Letters from M. Roy Thompson to Albert M. Johnson dated March 10, March 24 and March 25, 1929. Outgoing correspondence, manuscript 7, box 7.
15. Letter from M. Roy Thompson to Albert M. Johnson dated March 28, 1929. Outgoing correspondence, manuscript 7, box 8.
16. Letters from M. Roy Thompson to Albert M. Johnson dated May, 11 and May 31, 1929. Outgoing correspondence, manuscript 7, box 8.
17. Letter from M. Roy Thompson to Albert M. Johnson dated June 6, 1929. Outgoing correspondence, manuscript 7, box 8.
18. Letter from M. Roy Thompson to Albert M. Johnson dated January 11, 1930. Outgoing correspondence, manuscript 7, box 10. Letters from Charles Alexander MacNeilledge to M. Roy Thompson dated January 23 and 28, 1930. Incoming correspondence, manuscript 7, box 20.
19. Letter from M. Roy Thompson to Charles Alexander MacNeilledge dated May 27, 1930. Outgoing correspondence, manuscript 7, box 11.
20. See architectural drawings, catalogue nos. 21278 and 21279. A copy of a plan of the main floor is attached to this report.
21. Letter from M. Roy Thompson to Charles Alexander MacNeilledge dated February 28, 1928. Outgoing correspondence, manuscript 7, box 6.
22. Letter from M. Roy Thompson to Albert Mussey Johnson, dated March 10, 1929. Outgoing correspondence, manuscript 7, box 7. Some undated sketches labeled "Study For Guest House Lounge Room" or words to that effect are in the architectural drawings collection. See architectural drawings, catalogue nos. 20563, 20564, 20565, 20566, 20592, and 20593. Two drawings labeled "Ceiling Construction And Fireplace For Lounge" are also in the collection. See architectural drawings, catalogue nos. 20709 and 20710.
23. Conversation with Don Creech, August, 1987.

GARAGE - "LONG SHED" - BUNKHOUSE

Physical History

1. Date of Erection:

November 1922 - Johnson designed the Garage.¹

January 1923 - Johnson designed the Poultry House.²

November 1924 - Johnson designed the Shed.³

February 1926 - The Bunkhouse was complete enough for occupancy. The concrete slab roof of the shed was poured.⁴

March 1926 - Water pipe into the bunkhouse and the shed was completed.⁵

By March 1929 - The remodeling of the Garage in "Spanish Mediterranean" style was completed.⁶

1979 - National Park Service remodeled the interior of the Garage to accommodate a Gift Shop and Snack Bar.⁷

[with]

[approval, TW Services]

2. Architect:

Albert M. Johnson designed the original structures and Charles Alexander MacNeill designed the remodeling of the Garage. He also designed the few window and door trimmings that were added to the Bunkhouse. TW Services, the park's concessionaire, sponsored the interior remodeling of the Garage. The architectural firm of Hansen, Murakami, Eshima, Inc., Oakland, California, designed new doors, windows and infill for the doors and windows that were removed from the Garage. They also redesigned the interior of the Bunk House. Canteen Corporation, Chicago, Illinois, redesigned the interior of the Garage for use as a Snack Bar and Gift Shop.⁸

3. Original and Subsequent Owners:

Albert Mussey Johnson (c.1922-1948)
Gospel Foundation (1948-1970)
National Park Service (1970-Present)

4. Builder, etc:

General Superintendent - M. Roy Thompson

Building Superintendent - F. W. Kropf (1922-1924)
F. X. A. Kreil (1926-1927)
H. B. Brown (1927-1930)

5. Original plans and construction:

Johnson had been visiting Death Valley and its environs since 1906. His accommodations at that point consisted of tents or wooden shacks. In 1915 he began purchasing land and by 1922 started constructing more permanent structures.

The Garage, the westernmost part of the L-shaped structure, was designed by Johnson in November 1922. It was the first building constructed at the Ranch. The Reference Library has several original drawings of the Garage in Johnson's handwriting which are dated November 1922.⁹

What was originally designed to be a Poultry House was built soon after construction of the Garage, but was used as a bunkhouse for the workmen instead. The bunkhouse is the easternmost part of the structure. One drawing for it in the Library's collection is dated January 1, 1923.¹⁰ Another is undated and calls the building "Chicken Coop."¹¹

The Bunkhouse was originally intended by Johnson to be the Chicken Coop and it is so labeled on the drawing.¹² However, the need for employee housing was so great that workmen moved in before it was fully completed.¹³ Instead of having the chicken coop as a separate structure, Johnson incorporated it into the design for the "Long Shed" immediately to the west of the Bunkhouse.

The "Long Shed" spans the area between the Garage and the Bunkhouse. Two designs for the "Shed" are signed by Johnson and dated November 19, 1924.¹⁴ An examination of the building fabric itself indicates that the first four bays of the "Shed" were left open to the air and were infilled with wood and later plastered over. The next two rooms to the east were originally closed and probably either devoted to construction work or storage.

6. Alterations and additions:

Three of the four open bays were closed at a very early date, probably in the late 1920s. By 1929 the Garage and minor parts of the Bunkhouse and "Long Shed" were remodeled in the "Spanish Mediterranean" style similar to the other buildings at the Ranch. In the 1930s the "Long Shed," the Bunkhouse, and many of the rooms of the Garage were used as a Motel. Rooms were numbered from one to ten and ran from west to east. It might have been at this time that the auto pit of the one bay left open was infilled with concrete.

In 1974 Jerry Hampton and Fred Siedentopf, National Park Service employees, designed and built a Ticket Booth just west of the Garage. The new structure was built over the concrete island, now incorporated into the present structure, that might have originally served as a base for the two gas pumps. Their design was modeled after a photograph taken in the 1950s of a gas station in the parking lot.¹⁵

In 1976 the roof of the Motel was covered with foam in an effort to waterproof it.¹⁶

In 1979 the interior walls of the Garage were completely removed to accommodate its use as a gift shop and snack bar. Many entrance and garage doors were removed and stored in the Barn.¹⁷ At approximately the same time wooden posts were introduced to support the end of the canopy provided by the concrete roof cantilevered over the walkway in front of the "Long Shed."¹⁸ The National Park Service built a wooden bench to cover the grease pit west of the Garage and a wooden containment area for garbage. The grease pit is now used for storage of soda by the concessionaire.

Historical Context:

At one point Johnson considered hiring Frank Lloyd Wright as the architect for what Wright termed "Johnson's Desert Dwelling." Wright prepared at least twenty different drawings for the compound, eight of which are in the Reference Library's architectural drawing collection at Scotty's Castle. The remainder are in the possession of the Taliesin Fellowship in Scottsdale, Arizona. Although Johnson decided not to give Wright the commission, it is possible that Johnson was influenced by Wright and his highly publicized cantilever designs. Johnson went to great lengths to include a 158' concrete slab roof that cantilevers over the walkway in front of the "Long Shed" as part of the design.

A possibility also exists that Wright was greatly impressed by his visit to Death Valley Ranch sometime before 1924. In his autobiography Wright mentions how as he drove to the site, "Nature staged a show for us all the way." In 1927 Wright established his own desert home, Ocotillo Camp, outside Chandler, Arizona. At first it too consisted chiefly of simple canvas and wood structures. Like Death Valley Ranch, it was an early stage for much greater aspirations. It formed the basis for his later design for Taliesin West, his home and studio for many years outside Scottsdale, Arizona.¹⁹

1. Architectural drawings catalogue nos. 21324, 21325 and 21326.
2. Architectural drawing catalogue no. 21322.
3. Architectural drawings catalogue nos. 21296 and 21300.
4. Letters from M. Roy Thompson to Albert M. Johnson dated February 8 and 25, 1926. Manuscript 7, box 1.
5. Letter from M. Roy Thompson to Albert M. Johnson dated March 2, 1926. Manuscript 7, box 1.
6. Letter from M. Roy Thompson to Albert M. Johnson dated March 17, 1929. Manuscript 7, box 7.
7. Historic Buildings File. Record group 1, box 5.
8. Record group 1, box 5.
9. Architectural drawings catalogue nos. 21324, 21325 and 21326.
10. Architectural drawing catalogue no. 21322.
11. Architectural drawing catalogue no. 21348.
12. Architectural drawing catalogue no. 21348.
13. Letters from M. Roy Thompson to Albert M. Johnson dated February 8 and 26, 1926. Manuscript 7, box 1.
14. Architectural drawing catalogue nos. 21296 and 21300. The drawings for the Stables are also signed by Johnson and are dated November 15, 1924. (See Stables).
15. Conversation with Don Creech, September, 1987.
16. Historic Buildings File. Record group 1, box 5.
17. Ibid.
18. Conversation with Don Creech, August, 1987.
19. Henry-Russell Hitchcock, In The Nature of Materials (New York, De Capo Press, 1979), p. 78.

BARN / STABLES

Physical History

1. Date of erection:

1924 - Original barn designed by Johnson.¹

By 1926 - Original barn constructed.²

By August 1927 - MacNeilledge designed Barn remodeling and additions.³

January 1928 - New Barn practically completed.⁴

By March 1929 - Remodeling of Old Barn practically complete.⁵

2. Architect: Albert M. Johnson - Original Barn
Charles A. MacNeilledge - Remodeling and additions

3. Original and Subsequent Owners:

Albert Mussey Johnson: ca. 1926-1948

The Gospel Foundation: 1948-1970

National Park Service: 1970-Present

4. Builder, suppliers:

General superintendent: M. Roy Thompson

Building superintendent: H. B. Brown

Manufacturer of barn gate hinges: Julius Dietzmann's Ironworks, Los Angeles, California.⁶

Manufacturer of hand-wrought decorative gate fittings: Rubens Carascelli.⁷

5. Original plans and construction:

An earlier corrugated sheet metal structure as designed by Johnson in November of 1924 and built soon thereafter was called the "Stable." This term was still in use, although less frequently, long after MacNeilledge had prepared architectural drawings that specifically labeled both the north and south wings of the upcoming construction project as "New Barn" and "Old Barn" respectively.

The "New Barn" was planned from the outset to be one great open space specifically intended for storage. For that reason and because there would be no doors leaving it open to the air it was commonly referred to as the "Shed." The "Old Barn" had a room within it that MacNeilledge's plans labeled the "Stable." It was in this room that some mules were actually housed. All the horses were left to run free outside in the corral. In 1929 almost all the livestock were taken down to the Lower Vine Ranch, where they could live directly off the land and therefore save Johnson the expense of buying feed for them. Only some riding stock were left at the Upper Ranch.⁸

As the remodeling of the previous structure progressed, the term "Stable" was used less frequently, while the term "Barn" became more common. Today the entire complex is almost always referred to as the "Stables" and almost never as the "Barn."

The New Barn, or the Shed as it was commonly referred to, was built in 1927-28 and in great haste because it was needed for storage. There was a tremendous amount of building supplies and materials on order, in particular six train carloads of cement, that were necessary for the projects scheduled for the immediate future, and no place to protect them properly.⁹

Once the New Barn was completed, the pre-existing corrugated sheet metal structure, designed by Johnson in November of 1924 and built before 1926, was remodeled into its present form¹⁰ and called the "Old Barn." There are at least three drawings signed by Johnson and dated November 16, 1924, in the Reference Library at Scotty's Castle that are plans for a stable.¹¹ Unlike any of the other projects overseen by Thompson, there is little in the correspondence and the photographs sent by him to Johnson recounting the construction of this building. This seems to indicate that the original structure must have been started, and probably substantially finished, before Thompson became General Superintendent in October of 1925.

There is one photograph dated 1926 that shows the south side of this corrugated sheet metal building.¹² The photograph shows the stable with a central passage twice as wide as it is now and with no doors. A second photograph dated February 2, 1927, shows the west side of the original stable in the distant right background.¹³ This photo reveals that the whole side was left open with no walls or doors.

Correspondence between Johnson and MacNeilledge reveals that Johnson strongly disapproved of MacNeilledge's first scheme to lower the ridge of the original barn to match that of the new addition. Instead Johnson preferred making the addition match the original and in that way save on the expense of reframing this interior.¹⁴ There are two sets of drawings by MacNeilledge for the Barn complex: one dated 1927 and a second dated 1929, the second probably conforming more closely to what Johnson preferred.¹⁵ The second and later set makes note that the remodeling of the older structure should retain the original window and door openings. Except for some minor changes, in both cases the plan by MacNeilledge follows almost exactly the plan for the original stable as designed by Johnson in 1924.¹⁶ All this seems to point to the fact that most, if not all, of the original foundation, wood framing and interior partitioning was incorporated into the later structure. Only a smaller shed-roofed open air shelter on the west side was added anew. It was probably necessary architecturally so that the west ends of both the New and Old Barn were on line with each other and could each support one side of the west gate.

Along with the remodeling of the "Old Barn," a flat connecting roof with tiled parapets and large rounded arches was strung across from roof to roof at the east end, forming a covered driveway, in order to unite the parallel structures and have them read as a single structure. A very similar scheme was used in the remodeling design of the Main House Annex by adding a connecting footbridge toward the center and large arches and decorative gates toward the front and rear of a central throughway.

The later phases of the building's construction were not accomplished with the same sense of urgency since other projects (i.e., Guest House, Music Room, etc.) were determined to have a greater priority. Not until the summer of 1929 were all barn doors hung and November of the same year the Main Gates installed.¹⁷

6. Alterations and additions:

In July 1975 a water main shut-off was installed just south of the Barn to control the flow of water into the entire complex.¹⁸

In May 1983 a concrete pad was laid to the east of the Barn. In the following June two 2000-gallon propane tanks were installed.¹⁹

New Barn/Shed: In December 1979 - February 1980 the garage doors that were removed from the Garage/Motel were utilized as a free-standing partition on line with the west arch of the connecting roof. All the interior space east of the "garage door wall" was given a cement floor and is presently used by the National Park Service as lumber storage. In addition a smaller area within that was partitioned with gray-painted plywood for use as an electrical shop, formerly located three miles to the west at the Grapevine Maintenance Shop. A window was removed to accommodate an air conditioner. Nothing is permanent and all the work was done with the intention that it be reversible and could be undone when it became necessary or advisable.²⁰

In April 1977 the area to the north and east of the New Barn was re-excavated after a great deal of sand and gravel had been deposited there by a flash flood. What was originally below grade and never stuccoed is now exposed.²¹

Old Barn/Stable: What was originally the lumber room was adapted by the National Park Service in 1977-78 into a Maintenance Shop and Workers' Locker Room. At the same time concrete slab floors were added to this room and to the small dependency to the west. A free-standing plywood loft was introduced in the larger room in order to maximize storage and work space. The original sliding wood doors from the Annex Garage were used to form the north wall of the shelter.²²

In 1985 the east and west harness rooms were adapted for use as a Curatorial Storage Facility. Ceilings were insulated with foam to modulate temperature and humidity fluctuations. Free-standing plywood lofts, shelves and cabinetry were introduced in order to maximize storage capacity. A great deal of consideration was given to making sure no permanent damage was done to historic fabric.²³

1. See architectural drawings signed by A. M. Johnson and dated 11/15/24, catalogue nos. 21290, 21293, and 21310.
2. See photographs dated 1926, presently on file in the library of Deep Springs College, Deep Springs, California.
3. Letter from Charles Alexander MacNeilledge to Albert M. Johnson dated August 19, 1927. Manuscript 5, box 1.
4. Letters from M. Roy Thompson to Albert M. Johnson dated January 8, 14, 22, and 27. Outgoing correspondence, manuscript 7, box 6.
5. Letters from M. Roy Thompson to Albert M. Johnson dated March 6, 10, 17, 30 and 31, 1929. Outgoing correspondence, manuscript 7, box 7.
6. Letter from Charles Alexander MacNeilledge to H. B. Brown, dated June 20, 1929. Manuscript 7, box 21.
7. Letter from M. Roy Thompson to Rubens Caraselli dated June 21, 1929. Manuscript 7, box 21.
8. Architectural drawings, catalogue nos. 21289, 21293, and 21310.
9. Susan J. Buchel, "Scotty's Castle was Not His Home" (M.A. thesis, University of California, Riverside, 1985), pp. 52-53.
10. "I think the sketch of the new shed is all right and we will go ahead and excavate for same as soon as we start up, and the new building can be built along the lines of your sketch, as we need that at as early a date as possible for storage; and the old building and overhead bridge connecting the two can be reconstructed and built at a time that is most convenient and will fit in best with the other construction work." Letter from Albert M. Johnson to Charles Alexander MacNeilledge, dated August 8, 1927. Incoming Correspondence, Manuscript 5, Box 1.

11. See architectural drawings, catalogue nos. 21289, 21292 and 21310.
12. Photographs on file in the library of Deep Springs College, Deep Springs, California.
13. Album # 13732, photo # 1519.
14. Letters from Albert M. Johnson to Charles Alexander MacNeilledge dated November 15 and 22, 1927. Manuscript 5, box 1.
15. Architectural drawings, catalogue nos. 21289, 21290 and 21310.
16. The only major revision in the plan was that the large central pass-through was divided in half in order to create a second harness room.
17. Letter from M. Roy Thompson to Albert M. Johnson dated June 6, 1929. Outgoing correspondence, manuscript 7, box 7.
18. Historic Buildings File. Record Group 1, box 6. For more about the "Watercourse," see overview in HABS No. CA- .
19. Ibid.
20. Conversation with National Park Service electrician Bob Terrel, an employee with Scotty's Castle since 1976. July, 1987.
21. Historic Buildings File. Record Group 1, box 6.
22. Historic Buildings File. Record Group 1, box 6. Conversation with George Voyta and Don Creech on July 28, 1987. A photographic inventory done just after the National Park Service accepted ownership of Scotty's Castle has three photographs of the shelter when it was still open. The photographs were taken by Edward Jahns and can be found in "Physical Inventory of Contents: Stables and Environs..." and is on file at the Reference Library at Scotty's Castle.
23. Historic Buildings File. Record Group 1, box 6.

POWER HOUSE

Physical History

1. Date of Erection: 1929-30.

By January 1929 - Power House designed by MacNeilledge.¹
March 1929 - Plans left at the Ranch and excavation began.²
November 1930 - The Fairbanks-Morse diesel generator was operational.³

2. Architect - Charles Alexander MacNeilledge
Delineator - Martin de Dubovay

3. Original and Subsequent Owners:

Albert Mussey Johnson (1930-1948)
Gospel Foundation (1948-1970)
National Park Service (1970-Present)

4. Builder, Electrician, Manufacturer, etc:

General Superintendent: M. Roy Thompson

Building Superintendent: H.B. Brown (1929-1930)
C.G. Johnson (1930-1931)

First electrical system designed by Albert M. Johnson. Second electrical system designed by Raymond B. Goodrich.

Manufacturers of the three original electrical generators:

7-Kilowatt Direct-Current Generator - General Electric, Schenectady, New York.

30-Kilowatt Direct-Current Generator - Fairbanks- Morse and Co., Los Angeles, California.

110-Volt Direct-Current Type SK Generator - Westinghouse, East Pittsburgh, Pennsylvania.

Manufacturers of the two generators added later by the Gospel Foundation:

15-Kilowatt Direct-Current "Caterpillar" Generator - General Electric, Schenectady, New York.

75-Kilowatt Alternating-Current Generator - Delco, Dayton, Ohio.

Manufacturers of Storage Batteries - Edison Storage Battery Supply Company, Orange, New Jersey.

5. Original plans and construction:

From 1926 until recently, Death Valley Ranch produced its own power. At first individual Pelton Water Wheels, varying in size from 6 to 18 inches, were distributed to specific locations that required power. At least two, one in the shed by the garage and another in the Annex garage, ran power equipment for construction (e.g., bandsaw). Two others, one in the basement of the Main House and one in the Commissary,⁴ ran washing machines. Some of these locations retain their original Peltons and the concrete pedestals upon which they stood.

As the demands for power grew Johnson decided to connect an 18" Pelton Water Wheel, the largest he had at the Ranch, to a seven-kilowatt General Electric direct-current generator and in December 1926 Johnson designed the Ranch's first electrical plant.⁵ The generating facility became known as the "Power Room" and was located just west of the Commissary garage. The generator charged a series of one hundred six-volt Edison Storage Batteries that in turn provided electricity to the Main House. The batteries were stored underground in a tunnel just west of the Main House.

With the considerable electrical demands of the new Welte-Mignon theatre organ, J.C. Deagan Chimes System, and the impending electrification of several additional structures, Johnson decided to construct an entirely new facility that would house larger diesel-fueled generators. Compared to Peltons, diesel generators were much more powerful, but they also produced a great deal of smoke and noise and it was best to distance them from the actual living areas. The bluff 100 feet west of the Main House was chosen as the site for the "New Power House."

Two new generators were purchased: a 30-kilowatt Fairbanks-Morse diesel generator and a Westinghouse Type SK 110-volt direct-current generator. In addition all the six-volt batteries were exchanged with the manufacturer for an equal number of twelve-volt batteries.⁶

Excavation for the new Power House was begun in March 1929 with mules and wagons. The bluff west of the Main House consisted almost entirely of solid rock and this part of the work proceeded slowly. Excavation continued in this fashion for at least six months, when all construction was suspended temporarily due to the summer heat. The tremendous amount of excavation that remained for the Power House, as well as several other projects soon to follow (i.e. Tunnels, Swimming Pool, Entrance Gates) served as a justification for Thompson to purchase a Steam-Powered Shovel in November 1929.⁷ It was at this point that manual excavation was for the most part abandoned at Death Valley Ranch.

The Power House is made almost entirely of concrete and was formed in three separate phases. The actual Power Room, where the electrical generators and switchboards were housed, along with the main entry vestibule, were poured first. The retaining wall and the outside stairway to the south followed next. The hexagonal Pavilion up the hill and behind the Power Room was the last portion of the project completely formed.

The Pavilion served as a unifying link between the Power House and Chimes Tower. It was designed as a stopping point for those walking up the hill to the Chimes Tower and as an architectural counterpoint for the main body of the Power House. Original designs for the Pavilion included a smooth white plaster on the interior similar to that of the Power Room. Plans also called for low retaining walls to extend north and south of the Chimes Tower. Permanently discontinued shortly after they were begun, they were meant to define a fully landscaped area directly above the Power House and surrounding the Chimes Tower to be formally known as the "Plateau." This too was never completed.

From 1929 until 1930, a series of new electrical plans to distribute power throughout the entire complex were prepared by a professional electrician, Raymond B. Goodrich. By November 1930 the Fairbanks-Morse generator was operational. The electricity it and the other two original generators produced eventually powered every building at the Ranch.⁸

6. Alterations and additions:

Two diesel generators were added after 1948 by the Gospel Foundation. The first was a 15-Kilowatt Direct-Current "Caterpillar" manufactured by General Electric. This was followed by a 75-Kilowatt Delco Alternating-Current Generator. It was probably at this later juncture that most of the Ranch was rewired to accommodate the change in power supply. In 1964 commercial power was brought to the Ranch and the use of all the generators was for the most part abandoned. This later change in the power supply might also have required another complete rewiring.

1. Letter from M. Roy Thompson to Albert M. Johnson dated January 20, 1929. Manuscript 7, box 7.
2. Letters from M. Roy Thompson to Albert M. Johnson dated March 3, 1929 and March 21, 1929. Manuscript 7, box 7.
3. "We will have our 45 h.p. Diesel engine in operation on Saturday November 22 or possibly a few days before. This will give us adequate power for organ-blower and organ." Letter from Albert M. Johnson to J.H. Nuttal. Manuscript 7, box 12.
4. The first floor of the "Annex" built sometime in 1926 was originally known as the "Cellar." See architectural drawings, catalogue nos. 21297, 21298, 21299, 21308 21309. The easternmost room was used basically for storage and often referred to as the "Commissary." The structure as a whole was sometimes called the "Commissary Building." See architectural drawings, catalogue nos. 21318, 21319, 21332. Once the "Guest House" and "Music Room" were added and the entirety was remodeled in the prevalent "Spanish Mediterranean" style it became known as the "Annex."
5. See architectural drawing, catalogue no. 21328.
6. These batteries all still survive in their original location, although they are no longer functional.
7. A letter from M. Roy Thompson to Albert Mussey Johnson dated October 17, 1929. Manuscript 7, box 9.

I believe we ought to figure on getting a small power shovel at once, . . . One of these shovels will do the work of from 15 to 50 men . . . They are excellent for building side-hill roads and all other forms of excavation.
8. See architectural drawings catalogue nos. 21272, 21273, 21274, 21275, 21276, 21277, 21278, 21279, 21280, 21281, 21282, 21283, 21284, 21285, 21286, 21287, 21288.

CHIMES TOWER

Physical History

1. Date of Erection: 1928-29.

June 1927 - Johnson purchased J.C. Deagan sixteen-tone carillon.

By November 1928 - Tower construction began.¹

March 1929 - Tower construction practically completed.²

April 1930 - Nine additional tones and automatic roll player purchased.³

February 1931 - Construction of the concrete terrace surrounding the base of the Tower began, but never finished.⁴

1930 - The first chimes system was installed.⁵

1946 - The second chimes system was installed.

2. Designer - Charles A. MacNeilledge
Delineator - Martin de Dubovay

3. Original and Subsequent Owners:

Albert Mussey Johnson (1928-1948)

Gospel Foundation (1948-1970)

National Park Service (1970-Present)

4. Builder, manufacturer, etc:

General Superintendent - M. Roy Thompson.

Building Superintendent - H. B. Brown (1927-1930).
C.G. Johnson (1930-1931).

First chimes system installer - Roy Lofink.⁶

Second chimes system installer - James Boling.⁷

Manufacturer of chimes - J.C. Deagan, Chicago, Illinois.

Manufacturer of clockworks - E. Howard Clock Co., Boston, Mass.

Manufacturer of clockface tiles - The Spanish Pottery, Los Angeles, California.

5. Original plans and construction:

The Chimes Tower was originally conceived by Johnson as an element of the Death Valley Ranch complex that could either be incorporated as part of the Barn or stand in isolation on the hill to the west of the Main House. In 1927 Johnson instructed MacNeilledge to prepare drawings for either option. Johnson first thought that the sound of the chimes would be better from the stable and decided to place it there.⁸ Johnson then purchased a 16-tone chimes system and an automatic roll player from the J.C. Deagan Inc., in Chicago, Illinois.⁹

For reasons unknown, Johnson changed his mind and relocated the tower to its alternate location. Construction began in November 1928 and by March 1929 the basic four-story structure was completed. The brown and beige exterior stucco treatment and bandsawn "antiqued" wood trim echo the basic styling motif of most of the previous structures and remain faithful to the "Spanish Mediterranean" design scheme that MacNeilledge had established. Several new stylistic elements, however, were introduced since the first designs of the tower by MacNeilledge in 1927. The Medieval elements of Romanesque columns along the entry porch, the machicolation supporting the encircling stairway, false rustication of the base and the coat of arms centered within the Art Deco tile roof all point to a "Medieval" design sensibility that coincided with Johnson's hiring of a new architect, Martin de Dubovay, in 1928, as a draftsman in MacNeilledge's studio. This is approximately the same time that the decision to relocate the tower to its "west hill" location was made and might have also been related to the hiring of the new architect.

The new plans called for a fully landscaped area to be known as the "Plateau." It would extend from the roofline of the Power House to the east and completely wrap around the Tower's terrace to the west. The terrace and the paths leading to it were to be covered with flagstone. Low concrete walls north and south of the terrace running from the roofline of the Power House were to be bordered with plantings.¹⁰

In 1930, Johnson purchased an additional nine chimes and an automatic roll player.¹¹ Installation of the twenty-five tone carillon by the manufacturer was dependent upon the completion of the Power House, the installation of the diesel generator and the electricity it would provide. By November 1930, the first diesel generator was operational (see Power House) and installation of the chimes closely followed. With the additional purchase of the "Westminster Chiming Device" the chimes sounded out the quarter hour automatically.

In 1941, Johnson purchased a second-hand "harmonic" chimes system. This, like the previous system, could be played by an automatic roll player and a keyboard in the mechanism room of the tower. It was different from what he had previously, in that it could play more than a single note at a time. Since 1946, when the new system was installed, a smaller remote keyboard in the lower music room has been equipped to play it. The individual chimes range in size from approximately twelve feet to forty-seven inches in length.¹²

Worked on the chimes during the early 1970s.
~~In 1958 the J.C. Deagan Company went out of business after~~ *action in the*
~~producing and installing close to 500 of these systems across~~ *side the*
~~the country. Less than 100 survive today.~~ *pany]*¹³

6. Alterations and additions: An electric radio repeater was affixed to the side wall of the observation deck. It is used for radio communications with the Headquarters of the National Monument at Furnace Creek and was probably added soon after ownership was transferred from the Gospel Foundation to the National Park Service. In 1983 the Tower was re-wired.¹⁴ In April 1987 the chimes ceased to function.

1. "We have poured footings for the clock tower and are building new building forms for the walls up to ground grade." Letter from M. Roy Thompson to Albert M. Johnson, dated November 1, 1928. Manuscript 7, box 7.

2. "The outside of the chimes tower is also ready for final coat [of plaster]." Letter from M. Roy Thompson to Albert M. Johnson, dated March 31, 1929. Manuscript 7, box 7.

3. "Thank you kindly for the order given us for the nine additional tower chimes to be added to the equipment you already ordered and the Electric Player. Formal acknowledgment of order is attached hereto. We also acknowledge your remittance in the amount of \$2,500 which has been credited to your account." Letter from P.K. Neuses, J.C. Deagan, Inc., Chicago, Illinois, to Albert M. Johnson, dated April 21, 1930. Manuscript 7, box 11.

4. "The low wall around the chimes tower has been poured and will be backfilled as soon as the forms are removed." Letter from M. Roy Thompson to Albert M. Johnson dated February 13, 1931. Manuscript 12, box 4.

5. "Your letter of Dec. 27 was received, in which you enclosed money order for \$30.00 covering fifteen days room and board of the Chimes erector, Roy Lofink." Letter from Miss E. Devlin to M. Roy Thompson dated January 2, 1931. Manuscript 7, box 13.
6. Letter from Miss E. Devlin to M. Roy Thompson, dated January 2, 1931. Manuscript 7, box 13.
7. Correspondence with Mr. Boling is on file in the Reference Library at Scotty's Castle, Death Valley National Monument.
8. Letter from Albert M. Johnson to Charles Alexander MacNeilledge dated 7/26/27. Manuscript 5, box 1.
9. From the beginning Johnson wanted the Tower to be designed to accommodate a twenty-five tone chimes system. He planned, however, to purchase only a sixteen-tone system at first and the rest at a later date. Scotty's Castle Handbook, pp. 50-51.
10. See architectural drawing, catalogue no. 20078.
11. Letter from J.C. Deagan Inc. to Albert M. Johnson dated April 21, 1930. Manuscript 7, box 16.
12. The use of the word "chimes" in this case is a misnomer. Technically a chime is a straight hollow tube with the thickness of the metal remaining constant. Those purchased by Johnson were actually tubular bells because they had curved inner surfaces and irregular thicknesses in order to modulate the sound. Scotty's Castle Handbook, p. 50. Ironically they were confusingly marketed as the "Deagan Tubular Bell Tower Chimes." Advertising brochure found in manuscript 7, box 16.
13. Scotty's Castle Handbook, p. 50-51.
14. Scotty's Castle Historical Documents File. Record group 1, box 4.

SERVICE STATION / GAS TANK HOUSE

Physical History

1. Date of Erection:

November 1927 - Excavation for the gas tanks was completed.¹

January 1928 - Grading of the site began.²

By December 1928 - The basic structure was completed.³

February 1929 - The doors for the Service Station were made and the concrete floor for the Gas House was poured.⁴

June 1929 - The doors of the "Rock-Gas Room" were hung.⁵

November 1929 - The "Rock-Gas" tanks were installed.⁶

March 1930 - The landscaping of the area between the Cook House and the Gas House had been started.⁷

April 1930 - Gasoline Tanks were lowered into pit.⁸

January 1931 - The concrete wall to the east was poured.⁹

2. Architect: Charles Alexander MacNeillledge.

3. Original and Subsequent Owners:

Albert Mussey Johnson (1927-1948).
The Gospel Foundation (1948-1970).
National Park Service (1970-Present).

4. Builder, Supplier, Manufacturer, etc:

General Superintendent - M. Roy Thompson.

Building Superintendent - H.B. Brown - (1927-1930).
C.G. Johnson - (1930-1931).

Supplier of "Rock-Gas" - Imperial Gas Co., Long Beach, CA.

Manufacturers of gas pumps - Boyle-Dayton Co., Los Angeles, CA.

Manufacturer of gas tanks - Union Tank and Pipe Co., Ltd., Los Angeles, CA.

5. Original plans and construction:

Early plans and design studies depict the combination Service Station and Gas Tank House as one of a series of buildings known collectively as the Westerly Development or West Patio.¹⁰

In 1928 MacNeilledge prepared a revised design for the Service Station/Gas Tank House. The new plans located the structure directly east of the Main House and south of the Cook House. The Service Station was built to service not only the many cars and trucks that Johnson owned, but those of his many visitors and guests. It was also meant to supply all vehicles with gasoline.

The Gas Tank House was constructed to house four 32" x 120" tanks of "Rock-Gas." "Rock-Gas" was a commercial name for an early form of natural gas, similar to propane. This fuel was to be used for heating and cooking.

The gas tanks were connected underground to a service station island immediately west of the Garage. The island included two gas pumps and a small enclosed office. The entirety was covered by a gable roof supported by wooden posts and brackets covered with red clay tile. The pumps had been removed at some point and when the National Park Service took ownership of the castle it restored them to their original location.¹¹

6. Alterations and additions:

In 1931 plans were drawn to connect the Service Station/Gas Tank House to the Main House through an underground tunnel that would surface northeast of the building.¹² Construction began soon thereafter and completed before the summer of 1931.¹³

Two large additions were made by the Gospel Foundation in 1955 in order to accommodate the building's use as a snack bar and concession area. Two rectangular rooms were added southwest and northeast of the earlier structure, more than doubling the previous floor space. It seems that the Gospel Foundation roofed the room to the northwest which was left open when construction stopped.¹⁴ The Gospel Foundation used the Service Station as a kitchen for a snack bar. A large stovepipe fitting made of wood in the back wall, now filled with plywood, was built at this time. The addition in front contained some seating for patrons and a bookstore. The Foundation put a rock exhibit in the Gas Tank House and the room behind. Shelving was added in a part of the tunnel below for storage.¹⁵ The underground gas tanks were filled with sand to prevent the fumes from escaping.¹⁶

In 1979 the building was remodeled by the National Park Service to display interpretive exhibits about the history and construction of Scotty's Castle.

The specially designed doors for both the Gas Tank House and the Service Station have been removed, probably at the time the additions were constructed, and are now stored in the Barn. The two original wooden gas tank stands are now in the covered driveway area of the Barn. One of the original tanks with large stencilled letters spelling "ROCK-GAS" is also kept near the Barn.

Historical Context:

Propane and Natural Gas were new developments in the 1920s. "Rock-Gas" was one of several names under which this form of natural gas was marketed. Because of his engineering background and preoccupation with new technologies, Johnson was quick to join the many ranks of people switching from coal to natural gas for home heating and cooking. His plans included supplying at least two kitchens with it, one for Mrs. Johnson and one for Scott, and heating at least the Main House, Guest House and Cook House with this newly developed fuel.

1. Letter from M. Roy Thompson to Albert M. Johnson dated November 17, 1927. Manuscript 7, box 5.
2. Letter from M. Roy Thompson to Albert M. Johnson dated January 14, 1928. Manuscript 7, box 6.
3. Letter from M. Roy Thompson to Albert M. Johnson dated December, 1, 1928. Manuscript 7, box 7.
4. Letters from M. Roy Thompson to Albert M. Johnson dated February 15 and 20, 1929. Manuscript 7, box 7.
5. Letter from M. Roy Thompson to Albert M. Johnson dated June 11, 1929. Manuscript 7, box 8.
6. Letter from M. Roy Thompson to Albert M. Johnson dated November 13, 1929. Manuscript 7, box 9.
7. Letter from M. Roy Thompson to Albert M. Johnson dated March 30, 1930. Manuscript 7, box 10.
8. Letter from M. Roy Thompson to Charles Alexander MacNeilledge dated April 15, 1930. Manuscript 7, box 11.
9. Letter from M. Roy Thompson to Albert M. Johnson dated February 13, 1931. Manuscript 12, box 4.
10. The plans for the West Patio included a Service Yard, a Servant's Quarters, a Grotto, a Sunken Garden and Tea House and was originally meant to be built in between the Main House and Power House. It was only barely begun before all construction was halted in the summer of 1931. Although ideas and concepts for the West Patio were discussed as early as 1927, actual construction did not begin until 1931 and only a small portion of the foundation work was actually completed.
11. Conversation with Don Creech, August, 1987.
12. See architectural drawings, catalogue nos. 21064 and 21077.
13. Two photographs dated January 17, 1931, show the construction of the tunnel in progress. Photo album no. 13,733, pages 89 and 90.
14. Conversations with Esy Fields and Don Creech, August, 1987.
15. Conversation with Don Creech, August, 1987.
16. Interview with Mary Liddecoat.

ENTRANCE GATES AND DUNGEON APARTMENT / GATE HOUSE

Physical History

1. Date of Erection:

By December 1927 - Plans for Entrance Gates began.¹

June 1930 - Excavation for Entrance Gates was almost finished and Thompson received a copy of the blueprints.²

December 1930 - All the footings and walls up to grade had been poured.³

January 1931 - All concrete to the level of the top of the "wing walls" had been poured.⁴

May 1931 - All construction came to a halt.

1978- National Park Service completed the interior of apartment.

2. Architect: Charles Alexander MacNeill

3. Original and Subsequent Owners:

Albert Mussey Johnson (1930-1948)

Gospel Foundation (1948-1970)

National Park Service (1970-Present)

4. Builder, etc:

General Superintendent - M. Roy Thompson

Building Superintendent - H.B. Brown (1930)
C.G. Johnson (1930-1931)

5. Original plans and construction:

Plans calling for stone to be an element of the design for the entrance gates were considered as early as December 1927. At one point MacNeilledge wrote Thompson that he "thinks it would be a good plan to gather up all the rock in the flats and pile it near the new entrance gates . . . as I shall want to build a stone wall from the road connecting with the gates."⁵

Construction for the Entrance Gates, however, did not get underway until sometime close to June 1930. Work was interrupted at least once in October of 1930 when all the carpenters were fully engaged in the extension of the "gravel plant."⁶

The original drawings by MacNeilledge called for the entire structure to be faced with stone so as "to make it appear as if the structure were all ancient stone construction."⁷ The name "Death Valley Ranch" was to be carved in the arch spanning the entrance from the roadway. An apartment below the roadway, entitled the "Dungeon," was also originally planned in the original construction designs. Although all the exterior concrete walls were poured, the interior of the apartment was never even begun. Metal grilles similar to those of other structures were designed for the windows, but never installed.

At one point Johnson thought the "lower lake," a man-made impoundment of water from the natural spring up the canyon, would make a suitable swimming area for the workmen and the Indians.⁸

6. Alterations and additions:

In 1978 the National Park Service finished the interior of the "Dungeon" apartment. A concrete slab was poured on the plain dirt floor. Carpet and tiling were added over that. Interior walls were given a textured concrete surface and a dropped acoustic tile ceiling with recessed lighting was added. Window openings, which up till then had been boarded up with plywood, were equipped with metal-sash sliding-glass windows. The National Park Service filled in the roofs of each of the pylons, which until then had been left open to the air.

1. Letter from Charles Alexander MacNeilledge to M. Roy Thompson, dated December 6, 1927. Manuscript 7, box 20.
2. Letters from M. Roy Thompson to Charles Alexander MacNeilledge, both dated June 6, 1930. Manuscript 7, box 11.
3. Letter from M. Roy Thompson to Albert M. Johnson dated December, 30, 1930. Manuscript 7, box 13.
4. Letter from M. Roy Thompson to Albert M. Johnson dated January 9, 1931. Manuscript 12, box 4.
5. Letter from Charles Alexander MacNeilledge to M. Roy Thompson dated December 9, 1927. Manuscript 7, box 20.
6. Letters from M. Roy Thompson to Albert M. Johnson dated October 3, 1930 and October 16, 1930. Manuscript 7, box 12.
7. Letter from M. Roy Thompson to Nevada State Employment Office, Las Vegas, Nevada dated May 5, 1931. Manuscript 7, box 13.
8. Letter from Albert M. Johnson to M. Roy Thompson dated February 22, 1930. Manuscript 7, box 19.

SWIMMING POOL

Physical History

1. Date of Erection:

November 1925 - M. Roy Thompson prepared a sketch for the remodeling of the Main House that includes a large body of water in front that he labeled the "lake."

December 1925 - Thompson discussed the proposed swimming pool in a letter to Johnson.¹

October 1927 - Thompson estimated construction material needs for the "concrete work around the lake."²

January 1928 - Thompson suggested narrowing the bridge over the "lake."³

February 1928 - Grading for the lake began.⁴

June 1930 - H.B. Brown constructed the forms for the six arches in the center of the bridge, making them too high. He also set the "submarine lighting 8 inches too high."⁵

September 1930 - Carpenters finished the forms, placed the steel in the bridge and begin pouring the concrete for the bridge.⁶

October 1930 - Construction was held up until enough gravel could be produced by the new plant.⁷

November 1930 - Footings poured for north wall. Pouring of concrete for north wall was held up until plans of details for windows were received. Johnson was at the Ranch and wrote an angry letter to MacNeilledge.⁸

May 1931 - All construction stopped leaving the pool in much the state it is today.

2. Architect: Charles A. MacNeilledge (1926-1930)
Martin de Dubovay (1930-1931)

3. Original and Subsequent Owners:

Albert Mussey Johnson (1928-1948)
Gospel Foundation (1948-1970)
National Park Service (1970-Present)

4. Builder, etc:

General Superintendent - M. Roy Thompson

Building Superintendent - H. B. Brown (1926-1930)
C. G. Johnson (1930-1931)

5. Original plans and construction:

Plans for a large body of water in front of the Main House date from as early as November 1925 when Thompson prepared a sketch for remodeling the Main House that included a "lake" directly in front. Perhaps the undulating curves of the pool were influenced by this earlier sketch.

Designs prepared by MacNeilledge were incredibly fanciful and grandiose. His scheme included three different rock-lined watercourses that would empty into the pool, a large diving platform, arcades at various locations about the pool, alternating benches and flower pots to punctuate the tiled walk that would surround the perimeter, a water spout in the center of each end, underwater flood lights and a footbridge with a fountain. Only the flood lights and footbridge got beyond the design stage.

Johnson once said that completing the swimming pool would do more than anything else to make the Ranch feel complete. Some rumors suggest that Johnson sought estimates for the work as late as the mid-1940s.⁹

6. Alterations and additions:

Construction of the pool was discontinued in 1931 as was all construction for the unfinished projects at the Ranch. A great deal of steel reinforcement bar was left protruding from the concrete walls. Johnson died in 1948 and hopes of ever completing the pool died with him. Mary Liddecoat, the President of the Gospel Foundation, spent several hours of her spare time sawing down these protruding re-bars, believing them to be a hazard to the visiting public.¹⁰ It might have been at this time that metal stanchions and a chain link guard rail was added.

Historical Context:

The construction correspondence in the Reference Library of Scotty's Castle can be very confusing in relation to the construction of the pool. An early drawing by Thompson labeled the large body of water in front of the Main House a "lake." Thompson continued to use this term even though Johnson and MacNeilledge generally referred to it as a "swimming pool." At one point Johnson learned of certain health code regulations that would be relevant in the construction of a "pool" but not a "lake." He then instructed all concerned to use the term "lake" instead, although nothing about the design itself need change.

Perhaps because MacNeilledge's plans were so elaborate, he often found it difficult to meet certain established deadlines for construction. This caused Johnson to send first a telegram and then a letter stating how angry and upset he was.¹¹ This was not the first time MacNeilledge was delinquent in delivering plans on an agreed-upon schedule, but it is the first instance of any documentation of Johnson becoming so infuriated. Following this incident Johnson called MacNeilledge to the Ranch by telegram for a private discussion and soon after Macneilledge was fired. After that, the working drawings for the pool were signed by Martin de Dubovay. MacNeilledge's name block no longer appears on any of the later drawings.

1. Letter from M. Roy Thompson to Albert M. Johnson dated December 25, 1925. Manuscript 7, box 1.
2. Letter from M. Roy Thompson to Charles Alexander MacNeillledge dated October 10, 1927. Manuscript 7.
3. Letter from M. Roy Thompson to Albert M. Johnson dated January 29, 1928. Manuscript 7, box 6.
4. Letter from M. Roy Thompson to Albert M. Johnson dated February 28, 1928. Manuscript 7, box 6.
5. Letter from M. Roy Thompson to Charles Alexander MacNeillledge dated June 6, 1930. Manuscript 7, box 11.
6. Letters from M. Roy Thompson to Albert M. Johnson dated September 17 and September 24, 1930. Manuscript 7, box 12.
7. Letters from M. Roy Thompson to Albert M. Johnson dated October 8 and October 16, 1930. Manuscript 7, box 12.
8. Letters from M. Roy Thompson to Albert M. Johnson dated October 5 and October 9, 1930. Letter from Albert M. Johnson to Charles Alexander MacNeillledge dated October 12, 1930. Manuscript 12, box 12.
9. Conversation with Don Creech, August 1987.
10. Conversation with Esy Fields, August, 1987.
11. Telegram and letter from Albert M. Johnson to Charles Alexander MacNeillledge dated November 5 and 9, 1930. Manuscript 7, box 12.

GRAVEL PLANT / GRAVEL SEPARATOR

Physical History

1. Date of Erection:

By December 1925 - The previous "gravel pit," located "between the two springs" was made operational.¹

March 1926 - The operation was moved to its present location and referred to as the "gravel bunkers."²

August and September 1930 - Plans were prepared by Thompson to enlarge the facility.³

By October 1930 - The facility is enlarged to approximately four times its previous size and put into operation.⁴

2. Engineer: The system was probably designed by M. Roy Thompson and Albert M. Johnson in concert with The Stephens-Adamson Mfg. Co., the supplier of the machinery.

3. Original and Subsequent Owners:

Albert Mussey Johnson (1926-1948).
Gospel Foundation (1948-1970).
National Park Service (1970-Present).

4. Builder, Manufacturer, etc.:

General Superintendent - M. Roy Thompson

Building Superintendent - F.X.A. Kreil (1925-1927)
H. B. Brown (1927-1930)
C. G. Johnson (1930-1931)

Manufacturers of gravel washing, conveying and screening machinery - Stephens-Adamson Mfg. Co., Los Angeles, California.

5. Original plans and construction:

The first "gravel pit" operation was located "between the two springs." Men pushed wheelbarrows of dirt up a 40 foot incline, dumped them onto a 10 foot length of sloping corrugated iron and washed it all down over a half-inch screen to separate sand and gravel for use in construction.⁵ Because the soil there proved to contain too much sand, by March 1926 a "gravel bunker" was constructed in "the wash just west of the lower field." The new location necessitated the laying of 600 feet of 2" water piping to supply it with water.⁶

In August and September of 1930, Thompson oversaw the arrangements for the enlargement of the facility to almost four times its previous size.⁷ By October, construction was completed and Thompson was able to report that "[t]he new gravel and sand plant works perfectly and turns out excellent material at less than one-third the former cost. It will pay for itself in a short time."⁸ The facility was designed to handle "between one hundred and one hundred and fifty yards per day of sand and gravel."⁹

6. Alterations and additions:

The National Park Service is currently in the process of stabilizing the structure after many years of neglect and decay. Over the years flash floods have swept down the canyon and have buried the first few feet of the facility. The present plans include excavation of the lower portions of the timber cribbing and construction of large wooden braces banked into the sand to prevent the cribbing from bulging out any further. Plans to proceed beyond this point will be evaluated once this portion of the work is completed.

1. Letter from M. Roy Thompson to Albert M. Johnson dated December 31, 1925. Manuscript 7, box 1.
2. Letter from M. Roy Thompson to Albert M. Johnson dated March 16 1926. Manuscript 7, box 1.
3. Letters from M. Roy Thompson to Albert M. Johnson dated August 26, September 10, September 17 and September 29, 1930. Manuscript 7, box 12.
4. Letters from M. Roy Thompson to Albert M. Johnson dated October 3, October 8 and October 29, 1930. Manuscript 7, box 12.
5. Letter from M. Roy Thompson to Albert M. Johnson dated December 31, 1925. Manuscript 7, box 1.
6. Letter from M. Roy Thompson to Albert M. Johnson dated March 16, 1926. Manuscript 7, box 1.
7. Letter from M. Roy Thompson to Albert M. Johnson dated August 26, September 10 and September 17, 1930. Manuscript 7, box 12.
8. Letters from M. Roy Thompson to Albert M. Johnson dated October 3, October 8 and October 29, 1930. Manuscript 7, box 12.
9. Stephens-Adamson Mfg. Co., to M. Roy Thompson dated August 6, 1930. Manuscript 12, box 6.

SOLAR HEATER

The solar heater is a rare surviving example of a solar industry that thrived in Southern California before World War II and before the advent of natural gas.

1. Date of Erection:

May 1929 - The concrete platform was poured.²

June 1929 - Two tanks were erected and the grading for the coils began.³

September 1929 - The tanks were insulated.⁴

October 1929 - The Solar Heater was operational.⁵

September 1930 - The foundation and walls for Solar Heater extension were poured.⁶

Winter 1938 - The severe winter that year might have rendered the Solar Heater inoperable.

2. Designer: Charles Alexander MacNeilledge designed several different versions of a tower to house the Solar Heater's water tank that was never built. The system itself was designed by the manufacturer, Day and Night Solar Water Heater Co., Monrovia, California. Its placement and location were probably determined by Thompson.

3. Original and Subsequent Owners:

Albert Mussey Johnson (1929-1948)

Gospel Foundation (1948-1970)

National Park Service (1970-Present)

4. Builder, Supplier, etc.:

General Superintendent - M. Roy Thompson

Building Superintendent - H. B. Brown (1929-1930)
C. G. Johnson (1930-1931)

Manufacturer of Solar Heater - Day and Night Water Heater Co.,
Monrovia, California.

5. Original plans and construction:

There is one allusion in an early letter to placing the hot water tanks in the Chimes Tower. In that letter, Charles A. MacNeilledge suggested that the tanks of the Solar Heater be housed in a tower separate from the chimes.⁷

Thompson, the General Construction Superintendent, prepared at least two sketches that were probably attempts to locate the Solar Heater at sites other than it is now. The first, entitled "Sketch Showing General Layout of Buildings and Roads" dated 2-10-28,⁸ places the Solar Heater to the southwest of the Garage. Only the Solar Heater is penciled in; the rest of the sketched plan is in ink. A second sketch, entitled "Cross Section of Tunnel Under Lake To Solar Heater Plant," prepared on graph paper and dated 5-19-28, seems to be a working drawing that locates the Solar Heater south of the tunnel that passes under the swimming pool.⁹ These two drawings indicate that Thompson played a key role in its structural development and in its eventual siting.

MacNeilledge prepared at least two preliminary studies, both now in the Reference Library of Scotty's Castle,¹⁰ of a tower to house the tanks. Although each of the designs is different in some minor respects, both have a flattened hip roof covered with tiles, windows at the top center of each elevation and are similar to each other in most other respects.

When construction of the first four panels of "sun coils" was completed Thompson wrote, "The Tower Building around the tanks has not been started, as per your instructions, as you said you did not want it built until you came out."¹¹ No working or construction drawings for the Tower or Solar Heater are known to exist.

6. Alterations and additions: None. No tower was ever built.

Historical Context:

Construction on the Death Valley Ranch Solar Heater began at the end of May 1929, when a concrete platform was poured.¹² Within two weeks two tanks were set in place on the platform with guy wires.¹³ Six inches of hair-felt insulation, in three layers of two inches each, was wrapped around the tanks. Grading for the inclined concrete platform that supports the copper "sun coils" soon followed.¹⁴ By September, building paper, cheese cloth and a coat of waterproof paint provided additional layers of protection for the tanks against the weather.¹⁵ A letter in January 1930 from the General Construction Superintendent, Thompson, to Johnson mentions that, "Even in this cold season the solar heater is furnishing plenty of warm water, but it is not hot."¹⁶ In September of 1930 four additional panels of "sun coils" were constructed, perhaps in an effort to improve the output of hot water. One report mentions that one particular season of freezing weather damaged the Solar Heater severely and left it inoperable.¹⁷ The winter of 1938-1939 was severe enough to kill the three palm trees that had been planted in the entrance court directly in front of the main house, and this might have been the winter to which the above report refers.

1. Letter from Michael Luttrell to Jack Fields dated July 21, 1983. Record group 1, box 6.
2. Letter from M. Roy Thompson to Albert M. Johnson dated May 31, 1929. Manuscript 7, box 8.
3. Letters from M. Roy Thompson to Albert M. Johnson dated June 6 and June 11, 1929. Manuscript 7, box 8.
4. Letter from M. Roy Thompson to Albert M. Johnson dated September 25, 1929. Manuscript 7, box 9.
5. Letter from M. Roy Thompson to Albert M. Johnson dated october 17, 1929. Manuscript 7, box 9.
6. Letter from M. Roy Thompson to Albert M. Johnson dated September 17, 1930. Manuscript 7, box 12.
7. "Regarding the Tower for chimes. It may be necessary to design a detached tower to house the water tanks on account of the location of solar heater." Letter from Charles Alexander MacNeilledge to Albert M. Johnson, dated October 27, 1927. Manuscript 5, box 1.
8. Manuscript 7, box 2.
9. Manuscript 12, box 4.
10. Architectural drawings, catalogue nos. 21171, 21172, 21173 and 21174.
11. Letter from M. Roy Thompson to Albert M. Johnson, dated January 28, 1930. Manuscript 7, box 10.
12. Letter from M. Roy Thompson to Albert M. Johnson dated May 31, 1929. Manuscript 7, box 8.
13. Letter from M. Roy Thompson to Albert M. Johnson dated June 6, 1929. Manuscript 7, box 8.
14. Letter from M. Roy Thompson to Albert M. Johnson dated June 11, 1929. Manuscript 7, box 8.
15. Letter from M. Roy Thompson to Albert M. Johnson dated September 25, 1929. Manuscript 7, box 9.
16. Letter from M. Roy Thompson to Albert M. Johnson dated January 28, 1930. Manuscript 7, box 10.
17. Laura Soulliere, National Register Nomination, "Death Valley Scotty Historic District." May 1976.

ANNOTATED BIBLIOGRAPHY

ARCHITECTURAL DRAWINGS

The archives at Scotty's Castle contains 169 cataloged original architectural drawings related to the construction of the main house and 104 of the annex. These drawings include detail and section designs, sketches, elevations, and general, floor, ceiling, plot, and electrical plans.

Included are nine drawings by Frank Lloyd Wright. Approximately one dozen other drawings by Wright for the castle complex are in the collection at Taliesin West in Scottsdale, Arizona. The collection at Scotty's Castle has large format color transparencies of those at Taliesin. These drawings, however, are primarily of historical interest since Wright's plans and recommendations were rejected by Albert M. Johnson.

The castle curator has a computerized listing of these drawings. The list includes the drawings' titles but does not have dates.

ARCHITECTURAL BLUEPRINTS

The archives at Scotty's Castle contains 140 cataloged architectural blueprints related to the construction of the main house and 83 of the annex. These blueprints, which include some duplicates of the aforementioned drawings, include detail and section designs, sketches, elevations, and foundation, ceiling, floor, and roof plans.

The castle curator has a computerized listing of these drawings. The list includes the drawings' titles but does not have dates.

PHOTOGRAPHS

The archives at Scotty's Castle contains 769 cataloged black and white photographs of the main house and annex. Many of these photographs were taken during the period of construction. Of particular importance are the photographs in albums with catalog numbers 13,732 and 13,733. These photographs were taken by Matt Roy Thompson as part of his routine responsibility to report the progress made on the buildings to Johnson. The photographs, placed in leather bound albums denoted "Death Valley Ranch," graphically illustrate the history of ranch construction from December 1926 until 1931 when building operations ceased.

Burton Frasher, a professional photographer specializing in postcards, started taking photographs of the ranch in 1930. These photographs and postcards are among those cataloged.

The cataloged photographs cover the periods of construction (1926-31), Johnson's post-construction ownership (1932-47), and Gospel Foundation operation (1947-70). The major portion of the photographs date from the 1920s and 1930s.

Most of the cataloged photographs are in albums located in the archives. The catalog, however, includes some loose photographs not found in the albums. Xeroxed copies of the loose photographs are found in volumes in the castle curator's office.

The best source of photographs for the 1948-54 period may be found in two volumes in the castle curator's office. These volumes contain some 350 color slides taken by Merrill Rice, a frequent visitor to the castle during those years. This is the best collection of photographs for the Gospel Foundation period.

The researcher interested in finding photographs in the archives pertaining to construction/ post-construction of castle complex structures should consult the building photograph files in the castle curator's office. These files are organized by building and thereafter divided by exterior and interior views.

A volume entitled "1971 DSC Utility Systems" has photographs of existing conditions of the castle complex utility systems in that year, the first full year of operation after acquisition of the property by the National Park Service. The volume may be found in the castle curator's office.

Photographs of the main house and annex during the National Park Service period of administration (1970-present) are largely unorganized. A few, however, are included in the cataloged photograph list.

FILMS

The archives at Scotty's Castle contain several films dating to the late 1920s and early 1930s. The films, which are on video, provide footage relating to the construction of the castle complex as well as the personalities associated with its construction, ownership, and operation.

MANUSCRIPTS

The archives at Scotty's Castle contains the Historical Document Collection consisting of twenty manuscript collection groups. Several of these collection groups contain data relating to the conception, design, and construction of the main house and annex.

The Manuscript 2 collection consists of the Albert M. Johnson Family Papers (1899-1921) that reflect the family life, travels, religious beliefs, health, and physical activities of Albert through correspondence with his mother (Rebecca A. Johnson) and sister (Cliffe V. Johnson). The collection, consisting of five boxes, contains information about Johnson's early trips to Death Valley in 1905, 1907, 1913, 1916-17, 1919, and 1921.

The Manuscript 3 collection consists of the A.M. and Bessie Johnson Papers (1900-1909). The collection contains one box of copies of personal correspondence between Albert and Bessie Johnson and to the Johnsons from other family members. The letters, which have been copied from the Shadelands Ranch Historical Museum collections, provide valuable information about Johnson's early trips to Death Valley in 1905, 1907, 1908, and 1909.

The Manuscript 5 collection consists of the A.M. Johnson Letters (to Death Valley Ranch), 1926-32. This collection, consisting of six boxes, was donated to Scotty's Castle on September 20, 1983, by the Shadelands Ranch Historical Museum. The collection contains originals and copies of letters between Albert M. Johnson, Matt Roy Thompson, Charles Alexander MacNeill, and several others pertaining to the construction and maintenance of Death Valley Ranch. These papers originated in Johnson's Chicago business office.

The Manuscript 7 collection consists of Construction Correspondence (concerning Death Valley Ranch), 1925-37. This collection, consisting of 41 boxes, was found among the belongings of Albert M. Johnson at Death Valley Ranch. The collection is organized into six sections.

Section 1 (boxes 1-14) consists of the outgoing correspondence on file originating from Death Valley Ranch. Most of this correspondence consists of letters from Matt Roy Thompson to various companies concerning construction materials, Charles Alexander MacNeilledge relative to building designs, and Albert M. Johnson informing him of construction progress. Johnson's letters originating from Death Valley Ranch are also contained in this section. During Thompson's absences as construction superintendent some letters concerning construction were written by his assistants. This section of the collection is arranged chronologically.

Section 2 (boxes 15-25) consists of correspondence addressed to Death Valley Ranch. This section is arranged in alphabetical order using company or personal names. The most important construction-related files in this section are those from Albert M. Johnson and Charles Alexander MacNeilledge.

Section 3 (box 26) consists of employee correspondence and records. It contains letters from potential and actual employees as well as the payroll records from 1925 to 1931.

Section 4 (boxes 27-34) consists of invoices and bills of lading. The documents are arranged by company name alphabetically and thereunder in chronological order.

Section 5 (boxes 35-38) consists of miscellaneous construction-related files that could not be placed accurately in the aforementioned four sections.

Section 6 (boxes 39-41) contains building-related catalogs used during construction of Death Valley Ranch. The catalogs are filed by company name in alphabetical order.

The Manuscript 10 collection consists of the Edwin S. Giles files (1926-1928) while he was employed by Johnson to solidify his water rights at Death Valley Ranch. The collection contains four folders of xeroxed outgoing correspondence directed by Giles, County Surveyor of Esmeralda County, Nevada, to Johnson, Matt Roy Thompson, and various state and federal officials concerning water rights issues for the ranch.

The Manuscript 11 collection was formally transferred from the Gospel Foundation of California to Death Valley National Monument on December 6, 1983. The collection consists of four folders which include architectural drawings of Scotty's Castle showing use of the various rooms during the 1960s and papers concerning the modernization of the castle complex electrical system during that decade.

The Manuscript 12 collection, known as the Death Valley Ranch Papers Addendum (1926-31), consists of six boxes found among the belongings of Albert M. Johnson at Death Valley Ranch. It contains files maintained by Matt Roy Thompson during his years as construction superintendent at the ranch. The majority of the documents are direct correspondence between the ranch and the companies from which supplies were purchased. Other items include booklets, diagrams, cost estimates, and reports to and from Albert M. Johnson relating to companies and/or specific purchases. The materials are arranged roughly in alphabetical order by company name, but deviations occur.

The Manuscript 14 collection consists of three folders of correspondence from Albert and Bessie Johnson and letters concerning them between 1923 and 1937. The correspondence provides information on their personal, religious, and business lives. Some letters deal with the period following the termination of construction at Death Valley Ranch.

The Manuscript 15 collection, termed Death Valley Ranch Purchase Orders Paid (1923-310, was found among the belongings of Albert M. Johnson at Death Valley Ranch. The collection consists of four boxes, the documents being part of the castle complex record keeping system during the construction period. The collection, organized alphabetically by company name, documents the purchases of and payment for many of the materials and items used in constructing and furnishing the ranch buildings.

The archives at Scotty's Castle also contains the Administrative Files Collection, consisting of six record groups with working files relating to administration, operation, and maintenance of Death Valley Ranch by the National Park Service from 1970 to the present. Included in each record group are some files relating to structures in the castle complex. Record groups 1-3 and 6 contain records for:

- Record Group 1 – 1984-86
- Record Group 2 – Prior to 1975 (3 boxes)
- Record Group 3 – 1975-80 (25 boxes)
- Record Group 6 – 1981-83 (16 boxes)

Record Group 4 consists of five boxes of files selected from the Administrative Central Files kept at park headquarters in Furnace Creek because they pertained to Scotty's Castle. While some of these files date back to the 1930s, most pertain to the late 1960s and the 1970s.

Record Group 5 consists of files received from the Western Regional Office in 1985. The record group consists of one box of materials referring to Park Service acquisition of Scotty's Castle and the visit of the Advisory Board to the castle complex in the early 1970s.

The archives at Scotty's Castle also has one box of miscellaneous files, reports, photographs, and related correspondence and documentation, entitled "HSR Material from Mulhern." These materials were sent to Death Valley National Monument by the Western Regional Office in 1987. The records in this box are concerned with Park Service research and stabilization/preservation efforts at the castle complex during the 1970s and early 1980s.

A volume in the library at Scotty's Castle, entitled "Correspondence between A.M. Johnson and M.R. Thompson, dealing with construction of buildings," contains selected manuscripts for the period 1926-30. While the selected correspondence is not comprehensive in scope, it provides the reader with a sampling of available manuscript materials relating to construction.

At least six scrapbooks of newspaper clippings collected by the Johnsons and bound in album form are on deposit in the archives at Scotty's Castle.

A volume in the archives at Scotty's Castle, entitled "Gospel Foundation of California," contains various xeroxed documents pertaining to the legal and operational aspects of the organization that owned and managed Death Valley Ranch from 1948 to 1970.

TRANSCRIBED ORAL INTERVIEWS

The library and archives at Scotty's Castle contain the tapes and transcriptions of various oral interviews with persons having knowledge of the construction, operation, and maintenance of the main house and annex. Among the most important transcribed oral interviews are:

Interview of Pat Calhoun by George Voyta, December 29, 1982. Topics discussed include history and maintenance of Scotty's Castle with particular emphasis on tile.

Interview of Joseph Choate by Steven Harrison, January 22, 1980. The principal topic discussed is the legal case involving Scott and Julian Gerard, Choate having served as counsel for the former.

Interview of Lloyd Davey by Gary Hathaway and Steven Harrison, April 1, 1978. Davey was a workman on the ranch in the late 1920s and early 1930s and was involved with the installation of the organ.

Interview of Martin de Dubovay by F. Ross Holland, June 1972, 1978. Dubovay was a Hungarian architect hired to render intricate detail sketches for tile patterns, iron fixtures, wood carvings, and custom-made furniture for the castle complex as well as designs for the powerhouse and chimes tower.

Interview of Joseph Forcellia by [anonymous], May 1971. Forcellia was a workman at the castle during the construction period and was involved with laying tile.

Interview of Mrs. Fred Ford by Wayne Schultz and Dorothy Shally, March 5, 1974. Ford is the widow of Frederick William Kropf.

Interview of Melba Kropf Ford by Steven Harrison, January 21, 1980. Ford was the daughter of Frederick William Kropf, the first superintendent of construction at Death Valley Ranch during the early 1920s. She served as a cook for the workmen for some two years.

Interview of Burton Frasher, Jr., by Steven Harrison, January 22, 1980. Frasher was the son of Burton Frasher, Sr., the photographer hired by Johnson to take photographs of the main house and annex for sale as postcards in the early 1930s.

Interview of Milton Kropf by Steven Harrison, January 21, 1980. Kropf was the son of Frederick William Kropf and was himself a workman at the ranch during the 1920s.

Interview of Mary Liddecoat by Susan Buchel, March 17, 1983. Liddecoat is the president of the Gospel Foundation that owned, operated, and maintained the castle complex from 1948 to 1970.

Interview of Mrs. Charles Alexander MacNeilledge by Wayne Schultz and Dorothy Shally, March 5, 1974. Mrs. MacNeilledge was the wife of the architect for the castle complex.

Interview of Merrill Rice by Steven Harrison, December 28, 1979. Rice was a frequent visitor to the ranch and donated an extensive collection of color slides of the castle complex taken between 1948 and 1954.

Interview of Lee Sheidenberger by [anonymous] February 21, 1973. Sheidenberger and his father were contracted by MacNeilledge to produce much of the woodwork and furnishings in the main house and annex.

Interview of Christine Sorensen by John and Vivian Nash, May 9, 1979. Sorensen served as cook for the Johnsons.

NONTRANSCRIBED ORAL INTERVIEWS

Interview of Don Creech by Richard Bernstein, July and August 1987. Topics discussed include Park Service activities and management of Death Valley Ranch during the 1970s and 1980s.

VERTICAL FILES

There are numerous vertical files in the library at Scotty's Castle that contain data on the design and construction of the main house and annex. The most pertinent vertical files are:

1. Blue Diamond Building Materials
2. Circular Windows
3. Edison Storage Batteries
4. Fairbanks, Morse & Co.
5. Flash Gas Heaters
6. Gospel Foundation
7. Insulex
8. Roy Lofkin – Chimes Erector
9. Los Angeles Brick Co.
10. Masonry (Stucco, Cement, Plaster)
11. McEverlast Pipe Coating
12. Organ
13. Paint
14. Pelton Wheel
15. Scotty's Castle – Design and Construction
16. Scotty's Castle – Cement
17. Scotty's Castle – Chimes
18. Scotty's Castle – Electricity
19. Scotty's Castle – Chronology
20. Scotty's Castle – Early Buildings
21. Scotty's Castle – Fuel
22. Scotty's Castle – Lower Head Gate
23. Main House/Annex Chronology
24. Scotty's Castle – Power Room
25. Scotty's Castle – Roller Screens
26. Scotty's Castle – Stucco
27. Solar Heater
28. Smith-Booth-Usher Co.
29. Tiles
30. Matt Roy Thompson

31. Water Power
32. Frank Lloyd Wright

PRINTED REPORTS

There are a variety of printed reports concerning the structural history and maintenance of the main house and annex that may be found in the library at Scotty's Castle. Among the most significant are:

Beamer, Wilkinson & Associates. *Technical Analysis of Mechanical and Utility Equipment, Death Valley Ranch, Scotty's Castle*. 1973.

Elstner Associates, Inc. *Scotty's Castle Stucco Analysis*, by Wiss Janney. Emeryville, California, 1986.

Fidelity Appraisal Company. *Appraisal of Death Valley Ranch*. Los Angeles, 1960.

Micro-Chem Laboratories of San Jose, California. *Petrographic Examination of Stucco and Aggregate Samples*. 1984.

Real Estate Research Corporation, Los Angeles, California. *Appraisal Report, Scotty's Castle and Scotty's Ranch, Death Valley National Monument, Death Valley, California, as of May 1, 1969, NPS 14-10-4: 940-141*. Prepared for National Park Service, Western Region-San Francisco, California. June 1969.

Saxe, Myrna. *Preliminary Inspection Report of Exterior Redwood at DVSHD*. 1987.

URS/John A. Blume & Associates, Engineers. *Survey of Historic Structures: Southern Nevada and Death Valley*, by Charles D. Kensler. (Prepared for U.S. Department of Energy, Nevada Operations Office, Under Contract DS-AC08-76DP00099).

U.S. Department of the Interior. National Park Service. *Cultural Resources Survey: Death Valley National Monument*, by William Tweed. 2 vols., 1976.

_____. _____. *Death Valley Historical Report*, by L. Burr Belden. 2 vols., 1959.

_____. _____. *Death Valley National Monument, Draft Environmental Impact Statement and Draft General Management Plan*. 1988. (Also see Record of Decision)

_____. _____. *Death Valley National Monument, Historical Background Study*, by Benjamin Levy. 1969.

_____. _____. *Development Concept Plan, Scotty's Castle*. 1972.

_____. _____. *Evaluation of Stucco Deterioration at Scotty's Castle*, by Rich Borjes. 1982.

_____. _____. *Historic Furnishings Plan, Scotty's Castle*, by Linda Wedel Green. 1989. (Draft)

- _____. _____. *Historic Structure Report, Jasper Fountain, Great Hall, Main House*, by Robert Cox. Ca. 1977.
- _____. _____. *Historic Structures Condition Study, Death Valley National Monument*, by George A. Voyta and Donald Creech. 1980.
- _____. _____. *Inspection, Evaluation, and Recommendation Report*, by James Askins. 1982.
- _____. _____. *Inspection for Pest Infestation*. 1982.
- _____. _____. *Interpretive Prospectus, Death Valley National Monument*, by Tom White. 1989. (Draft)
- _____. _____. *Physical Inventory of Contents: Stables and Environs, Tie Canyon, "Motel Unit" Garage, Scotty's Castle, Death Valley National Monument*, by Edward Jahns. 1971.
- _____. _____. *Scotty's Castle Cook House: Historic Structure Report*, by Susan Buchel. 1985.
- _____. _____. *Scotty's Castle Furnishings, Death Valley National Monument, California*, by Katherine B. Menz. 1979. (Draft)
- _____. _____. *Structural Flood Mitigation, Death Valley Flood Studies*. 3 vols., 1985-88.
- _____. _____. *Structural Report: Death Valley, Scotty's Castle and Furnace Creek Area*, by Clement P. Diessner. 1976.
- _____. _____. National Register of Historic Places. "Death Valley Scotty Historic District" (Approved nomination form entered on National Register, July 20, 1978).

PUBLISHED WORKS

There are numerous published works relating to the historical development of Scotty's Castle and Death Valley Ranch. The following include the most significant publications that provide historical background and context for the structural evolution of the castle complex:

- Butti, Jen, and Perlin, John. *A Golden Threat: 2500 Years of Solar Architecture and Technology*. Palo Alto, California, Van Nostrand Reinhold Company, 1980.
- Hitchcock, Henry Russell. *In the Nature of Materials: The Buildings of Frank Lloyd Wright, 1887-1941*. New York, Durell Sloan and Pierce, 1942.
- Johnson, Bessie. *Death Valley Scotty by Mabel*. Death Valley, Castle Publishing Company, 1941.
- Johnson, Russ. *Death Valley 1933 Scrapbook*. Bishop, California, Chalfant Press, 1983.
- Johnston, Hank. *Death Valley Scotty: The Fastest Con in the West*. Corona Del Mar, California, Trans-Anglo Books, 1974.

- Lingenfelter, Richard E. *Death Valley and the Amargosa: A Land of Illusion*. Berkeley, University of California Press, 1986.
- Marquis, Albert Nelson, ed. *Who's Who In Chicago*. Chicago, A.N. Marquis Publishing Co., 1926.
- Mayer, Harold M., and Wade, Richard C. *Chicago: Growth of a Metropolis*. Chicago, University of Chicago Press, 1969.
- Paher, Stanley W. *Death Valley's Scotty's Castle: The Story Behind the Scenery*. Las Vegas, KC Publications, 1985.
- Shally, Dorothy, and Bolton, William. *Scotty's Castle*. Yosemite, California, Flying Spur Press, 1983.
- Wheelock, Walt. *The Founding of Death Valley National Monument*. Death Valley, California, Death Valley Forty-Niners, Inc., 1983.

THESES

The following thesis provides a historical study of the background and development of the Scotty's Castle area:

- Buchel, Susan. "Scotty's Home Was Not His Castle: A Historical Study of Death Valley's Lower Vine Ranch, Death Valley National Monument." Unpublished M.A. thesis, University of California, Riverside, 1985.



Photo by Jack E. Boucher, Historic American Building Survey,
HABS No. CA-2257 AA-34, ca. 1987-89.

EXISTING CONDITIONS AND RECOMMENDATIONS

Robert L. Carper, Historical Architect

Architectural Significance and Character Defining Features

Building Uses

Pest Management

Concrete Preservation

Brick Preservation

Tile Assessment

Annex Second Floor Patio

Wood Preservation

Color Assessment

Fountains Assessment

Courtyard Arbor

Recommendations Summary and Assessment of Effect

C. Craig Frazier, Historical Architect

Robert L. Carper, Historical Architect

Observation Tower Deck

Steven J. Bainbridge, Civil Engineer,

Storm Drainage Assessment

Richard L. Silva, Structural Engineer

Daniel B. Tower, Structural Engineer

Structural Assessment

Seismic Assessment

David E. Snow, Historical Architect

Stucco Assessment

Metals and Glass Preservation

Andrew M. Roberts, Mechanical Engineer

Paul C. Cloyd, Historical Architect

Environmental Controls Assessment

Andrew M. Roberts, Mechanical Engineer

Robert L. Carper, Historical Architect

Fire Suppression and Plumbing

E.J. Franz, Electrical Engineer

Electrical, Security and Fire Detection Systems Assessment

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ARCHITECTURAL SIGNIFICANCE AND CHARACTER DEFINING FEATURES

Death Valley Ranch, or Scotty's Castle and Ranch, was entered into the National Register of Historic Places on July 20, 1978 as Death Valley Scotty Historic District. There are two units of the district, the Death Valley Ranch or Scotty's Castle unit, and the Lower Vine Ranch, also called Lower Grapevine Ranch or Scotty's Ranch. Excerpts from the National Register nomination are included here as reference and as a basis for discussion of factors of significance.

NATIONAL REGISTER BASIS

This chapter is oriented primarily toward architectural significance and character defining features and related areas rather than the history aspects of the site. All quoted material in this chapter is from the National Register nomination form unless otherwise noted.

Among the areas of significance indicated on the nomination form are architecture, art, invention (technology), social/humanitarian, and folklore. As related to technology, engineering should be added, at least applied engineering.

The Death Valley Scotty Historic District is an area of Regional significance in the field of 20th century architecture, folklore and social history, and of local significance in the fields of archeology, art and invention. (Individually, the Main Castle and Annex are of Regional significance in those fields, and all other structures are of local significance.)¹

Location

The Death Valley Scotty Historic District is of Regional architectural significance for several reasons. The choice of style for the Castle and Annex area is not unusual in California architecture. The particularly unique aspect of that choice, however, lies with its location. Because of the use of stucco and red mission tile on wood frame and concrete buildings, enormous amounts of building materials had to be hauled in to the isolated site at great expense. Construction with local, available material would have been a far more economic choice. However, concern with economy was not a major factor in the design. As has been stated so often, the structure would not have been out of the ordinary in Beverly Hills, but it certainly seems extraordinary at its site on the outskirts of Death Valley.²

"The choice of such a barren and isolated location, more than any other reason, makes Death Valley Ranch unique."³

1. Significance section, National Register of Historic Places Inventory -- Nomination Form, prepared August 1976.

2. Ibid.

3. History, p. 28.

Construction Techniques

Coupled with and inseparable from the architectural significance of the District is the local invention/technology significance. Johnson used several types of construction techniques and some innovative materials, the combination of which has caused certain structural problems. The major materials and construction types include reinforced concrete, wood frame, hollow building tile, "Insulex" foam insulation and stucco. The problems are spalling concrete, cracked stucco, stucco and mesh backing separating from the structure, broken tiles, and advanced deterioration in the environmental control systems....⁴ The concern with experimentation is demonstrated in the new building techniques, materials and systems. While Bessie Johnson was allowed her freedom in choice of design and style, Albert Johnson pursued his interest in engineering and construction with the solar water heater, the Pelton Hydro-electric wheel, the use of "Insulex" and the hundreds of feet of utility tunnels connected with the Castle.⁵

Engineering Prototypes

Johnson's fascination with technology took many forms. The solar heater, although used only for a short period of time, exemplifies his concerns. The Pelton Wheel, the chime mechanism and the complex theater organ are other features which should be protected and are prime interpretive material.⁶

Architectural Uniqueness

The buildings are typical of a particularly Californian style of the 1920's and 1930's, which combines Mexican, Spanish, and Mediterranean influences with their rambling floor plans, open air patios and porches, and outdoor living spaces. The style includes architectural detailing of turrets and balconies, gently pitched gable roofs finished with red mission tile, and an off-white stucco finish. The style is romantic and very suitable for its environment.⁷

The...buildings are constructed in a style which is a conglomerate of Mediterranean influences, called "old Provincial Spanish" by Bessie Johnson.⁸

4. The term "environmental control systems" is not a correct description. The historic heating system is inadequate and deterioration is causing fabric damage [three steam line failures occurred at the beginning of the 1990-91 heating season, one of which damaged interior plaster]. Although portable humidifiers are in use, there is no integrated and adequate environmental control system.

5. Significance section, National Register nomination form.

6. Ibid.

7. Description section, National Register nomination form.

8. Ibid.

Craftsmanship

Common to both structures [Main House and Annex], in addition to the exterior styling, is the craftsmanship of the interior furnishings and architectural fittings and details. The buildings abound with tilework completed by master craftsmen, hand-wrought iron hinges, handles and latches on all doors and windows, massive redwood beams which were hand-finished with an alcohol torch, enormous hand-built chandeliers, and a tile and jasper fountain. The tables, chairs, curtains, tilework, and even dinner china were either designed or specifically chosen for Death Valley Ranch. Most of the furnishings were constructed in a workshop which Johnson organized in Los Angeles for the purpose of carrying out the furniture designs of Charles MacNeilledge and others.⁹

Significance in terms of art and architecture can be found in the interior furnishings and structural details. The emphasis of the buildings of the Castle complex is on the fine, hand-crafted details. The furnishings, except for the European antiques, were designed and built in a workshop in Los Angeles which Johnson created for the sole purpose of outfitting the Castle. Charles Alexander MacNeilledge, the designer perhaps most responsible for the design stipulations of the Castle, took great pains in specifying every detail of the furnishings and fittings, down to the last hand-wrought iron door hinge. The tilework in the Main House and Annex is considered by experts at the Tile Institute of America to be some of the better examples of their craft on the west coast. The Tile Industry News calls the work at the castle: "a monument in itself to the tile industry." The overall architectural importance of the Castle area is in its 1920's upper middle-class approach to architecture. At that time, much of the contemporary idea of quality rested in details such as the carved beams and tilework, rather than with structural integrity and an honesty of materials in relation to the building....The wood frame walls of the Main House and Annex are finished with stucco, which gives the buildings the illusion of being constructed of adobe. Thus, the image-evoking details were emphasized rather than the structural integrity.¹⁰

The interior decoration and furnishing in the buildings are an integral part of the significance, since every piece was specifically made for or chosen for the Castle.¹¹

DISCUSSION

It is this writer's view that the level of significance of most structures of Death Valley Ranch should be upgraded to national significance in architecture and engineering. The architectural significance lies not so much in the styles but rather that (1) the design of features and the use of materials are unique, especially of the interior, and (2) the features of the buildings are an in-place exhibit of building craftsmanship. These factors apply to the furnishings also (the art category).

9. Ibid.

10. Significance section, National Register nomination form.

11. Ibid.

Design Concepts

Design concepts, as described in the National Register nomination, were predicated on creating images or impressions of currently popular architectural or interior decorative styles. Although rooms or groups of rooms were based on an Italian, Spanish or Gothic motif, these variations are subtle and do blend into an overall character, which however defies a precise label.

Material Treatment

Treatment of materials was a major element of the design concept and construction process. Although an aged or "antique" character was intended, an emphasis on quality of craftsmanship was emphasized. The permanence, weatherability and low maintenance of materials was important and the best were used, yet techniques were utilized to create the illusion of age. Finish treatments were developed and specified by MacNeilledge to obtain the intended character. Undoubtedly the craftsmen had to experiment and develop unusual techniques as well, while still providing high quality craftsmanship and finishes.

Craftsmanship and Tile

The attention to design detail and the high level of craftsmanship is evident in every material and detail. There was an insistence on precise layout and execution illustrated in historic documents. As an example, much of the tile was specifically designed for these buildings and the motifs intended for the various rooms. Design drawings were done for the tile manufacturers, who in turn provided specific instructions for layout and setting. MacNeilledge personally instructed the tile setters on layout and execution and would order the work redone if it did not suit him.

Wood

Redwood is predominant for exposed features, whether structural or purely decorative, exterior or interior. The uniqueness of the wood features is the result of a wide variety of carving and finish treatments. Exterior eaves, rafter ends, brackets, balconies, door and window headers, roof trim, doors, window grills, gates and shutters range from simple members to the ornate. The wood was typically burned, brushed and finished to create an aged appearance while still emphasizing a natural wood grain as well as providing a protective coating. Interior wood beams and other features were carved with floral and abstractly organic designs within a thematic context for a room or group of rooms. The carving was selectively color highlighted in "faded" colors, the woodwork "antiqued" by burning and brushing, then stained or clear coated according to the room theme or degree of protection needed.

Stucco

MacNeilledge apparently spent considerable time experimenting with stucco and plaster mixes and application techniques to achieve a set of textures and colors to express the intended decorative schemes.

Metalwork

Hardware for doors, shutters and cabinets were individually conceived and treated. Even when commercially available stock hinges were utilized, they were often modified, either with added parts or a particular finish. The hardware finishes were specified to be consistent with the both the overall character of the buildings as well as the theme of each room or group of rooms. In the same manner, light fixtures were designed, produced and finished to be integral with the theme for a room.

Furnishings

This individualized, integral design concept was a major factor in the total approach to the project and was carried out in furnishing the buildings. All the furnishings were either designed and built solely for Death Valley Ranch or when purchased were selected carefully (and some of the purchased items were even refinished) to fit the decorative scheme.

Engineering

With respect to engineering, the application of state of the art concepts, materials, equipment and systems resulted in unique applications and features.

In order to provide electricity for the complex, a number of small Pelton wheels were installed at various locations. Later as the complex was developed in its more complete form, Johnson had a powerhouse built and equipped with both Pelton wheel and the latest power generators. Even a bank of electrical storage batteries for emergency power was installed in the tunnel near the Main House. Although needing some repair and restoration, the Pelton wheel generator in the Powerhouse is still operating but does not have the capacity to serve today's power requirements. It is used to provide nighttime exterior site lighting.

There was an attempt to provide cooling for the Main House by utilizing the tunnel beneath the swimming pool. A fan circulated air over water saturated burlap panels hung in the tunnel. Pushed into the basement, the cool air could circulate through the house by convection through vertical ducts to the first and second floors. It is not known however how long the system was kept in operation.

One of the earliest solar water heaters was constructed near the Annex. It did supply domestic hot water for a short period of time. Unfortunately the system is in a state of considerable disrepair.

A network of approximately 1/4-mile of concrete utility tunnels interconnect the Main House, Annex, Powerhouse, Gas House, the Guest House (Hacienda) and the swimming pool, providing convenient access for maintenance and repair.

Johnson's interest in systems was also related to the organ of the Upper Music Room and the Deagan chime in the clock tower. These systems could be controlled and played automatically, even remotely from the Lower Music Room in the Main House. Incomplete installations and the drawings for the Ranch show that there were other systems either intended to be installed or proposed. Swimming pool fountain and water jets could be activated from the front porch of the

Main House. The historic drawings indicate consideration was given to providing a searchlight in the Main House Observation Tower. MacNeilledge's drawings indicate a projection screen for the Annex Upper Music Room which could be stored in a wall pocket in the partition between the two pipe rooms behind the orchestra, and accessed by a hinged panel from the orchestra.

CONCLUSIONS

Architectural Significance Summary

The development of this stylized architectural group in such an isolated location required not only a large financial outlay on Johnson's part, but logistics planning for transporting materials. Although the architectural style was popular in southern California during the period, the materials, textures and colors are an appropriate character in the desert setting.

More important than architectural style is the significance of the integration of design themes throughout the buildings in materials, fixtures and furnishings. "State-of-the-art" construction techniques were utilized, as well as the best materials available. Innovation in construction and the use of materials and systems was important to Johnson in his project. Engineering systems are significant features, including the solar water heater, the electrical systems, utility distribution tunnels, the organ and chime systems.

Craftsmanship exhibited in the material treatments, including tile, wood, stucco, fixtures and furnishings provides a tribute to the skills of the craftsmen who produced them. This alone is a reason for national significance status of Death Valley Ranch.

CHARACTER DEFINING FEATURES

Exterior

Placement of buildings relative to each other to create a village-like atmosphere and to create framed views of individual buildings.

Although the buildings are fairly simple in plan layout, multiple roof planes and shapes, balconies, towers, retaining and connecting or enclosure walls, porches and numerous decorative and textural features create highly interesting visual compositions.

Red mission tile roofs, tiles laid in a "random" pattern and usually partially bedded in cement mortar.

Stuccoed walls, with variegated texture and color treatment, to have a weathered appearance.

Tile paving and decks, wall copings, chimney caps usually in red tile; decorative elements in patterned tile.

Redwood eaves, rafter ends, brackets, balconies, door and window headers, roof trim, window grills, gates and shutters; the wood was often burned, brushed and finished to create an aged appearance.

Window placement, metal casement sash multi-light style except fixed single pane in Solarium.

Unfinished concrete structural elements in uncompleted portions of complex.

Metal hardware, light fixtures and other structural/decorative features crafted and finished to specific design and specifications within the character and aged appearance concept.

Interior

Each room or group of rooms designed and finished for a specific stylistic theme (Spanish, Mexican, Italian, Gothic). Detailing and material finishes follow those themes as well as the aged or "antique" appearance. Typically ceilings are wood, walls plaster, floors tile but each room is a different design.

Wood beams and other features carved with thematic design, carving color highlighted in "faded" colors; woodwork "antiqued" by burning and brushing; stained or clear coated according to the room theme.

Plaster finishes designed and executed for the stylistic theme.

Patterned tile flooring, wall bases, kitchen counters, grills, and other decorative tile features; most designed, some purchased, specifically for the room theme.

Metal hardware, light fixtures and other functional/decorative features crafted and finished to specific design and specifications within the character and aged appearance concept.

Furnishings designed and fabricated or purchased to meet the design theme(s). The building interior and furnishings are integral and inseparable.

BUILDING USES

PLANNING BACKGROUND

General Management Plan

The draft General Management Plan/Environmental Impact Statement, 1988, contains pertinent information relating to this report as well as proposals affecting uses within Death Valley Ranch:

Currently Scotty's Castle is being managed to preserve the interior as it appeared in the 1930s and the grounds and other structures as they appeared at the time of Scotty's death in 1954.¹²

However, the Record of Decision, General Management Plan/Final Environmental Impact Statement, April 18, 1989, modified those dates:

The interpretive period for furnishing the first and second floors of the main house and the second floor of the annex is 1934 through 1941. This does not preclude, however, the use of earlier or later data where none exists for the interpretive period. The structure exteriors and grounds of Scotty's Castle will be managed and preserved as they appeared during the early 1950s through Scotty's death in 1954, including alterations made to Windy Point for his burial and the grave site memorials which followed. With respect to the historic resource study/historic structure report, the study would also determine other possible periods of significance for the structures and grounds at the Castle and Lower Vine Ranch.

Problems are summarized in the GMP as related to Scotty's Castle:

At Scotty's Castle problems related to visitor use include large asphalt areas that detract from the historic setting, vehicle and pedestrian conflicts, occasional long waits for tours, and the lack of pleasant sitting areas or options to explore adjacent areas while waiting. Administrative, maintenance, and curatorial functions at Scotty's Castle are housed in various historic structures, which is inefficient and possibly not the best use of these structures.¹³

Water and power are limiting factors for any expansion of management facilities at Grapevine.¹⁴

Storage facilities for museum collections are inadequate, which could result in some items being irreversibly damaged, adversely affecting future interpretive and research programs.¹⁵

12. Draft General Management Plan and Draft Environmental Impact Statement, Death Valley National Monument, California and Nevada, United States Department of the Interior, National Park Service, 1988, pg. 42.

13. Ibid., pp. 9-10, 67.

14. Ibid., pp. 10, 67.

15. Ibid., pg. 67.

Proposals found in the GMP are:

To meet long-term [museum] collection management needs at Death Valley, new storage facilities with environmental controls and storage equipment would be developed.¹⁶

The GMP indicates discontinuation of the use of the bridge and Annex apartments for employee housing.¹⁷ Also:

(The use of apartments in historic structures at Scotty's Castle might also be discontinued if the historic resource study/historic structure report determined that residential use was not acceptable. However, housing would be provided for security personnel.)¹⁸

The GMP indicates the need for 46 housing units (of various types) for Scotty's Castle/Grapevine, with 7 (8 is also indicated) existing usable units; and that "This plan assumes that only three would continue in use for security purposes. The determination on continued use of these structures must await completion of the historic resource study/historic structure report."¹⁹ Thirty five units are proposed for construction at Grapevine.²⁰

General development concepts presented for Scotty's Castle are:

The concessioner food services and curio sales would remain the their present locations pending the completion of a historic resource study/historic structure report and a grounds study. These studies would help determine appropriate uses of the historic structures. When the studies were completed, a development concept plan would be prepared to establish various facility requirements, the need to relocate maintenance and storage functions, visitor circulation patterns, the number of employees, and the location of employee housing. That plan would also determine whether the gas station and visitor parking should be relocated out of the floodplain....

If compatible with the historic resource study/historic structure report, additional structures would be opened for public tours, and some could be adaptively used for exhibit space, audiovisual presentations, and curatorial space. Picnicking and rest areas would also be redesigned and improved, and the landscape would be restored where appropriate to provide shade and waiting areas.²¹

16. Ibid., pg. 43.

17. Ibid., pp. ix, 46.

18. Ibid., pg. 46.

19. Ibid., pg. 47.

20. Ibid., pg. 61.

21. Ibid., pp. 51-52.

For the Grapevine area:

Some NPS and concessioner employees now residing at Scotty's Castle would be relocated to Grapevine....Some maintenance functions could be relocated from Scotty's Castle, and the museum quality items now stored in various buildings at the castle would be moved into a climate-controlled structure at Grapevine to ensure their preservation (if appropriate space could not be found at the castle).²²

The development of such facilities also depends on the feasibility of providing water and power.²³

Discussion. The following are some comments regarding various problems or proposals discussed in the GMP:

Apparently an additional limiting factor to be evaluated in planning for facilities at Grapevine is the possibility of a fault line near or through the area.

Storage of museum collection materials is an inappropriate use of certain historic interior spaces. Additional discussion of this problem is included below.

Employee housing has been discontinued in both the Gatehouse and the Annex. Some housing use in appropriate buildings of lesser significance is valid for protective personnel living on-site. The Bunkhouse/Motel would seem to be appropriate for such housing, although eventual interpretation of part of this structure has been proposed. The Garage interior has been extensively altered so retention of food service and curio sales here would be appropriate. The main floor of the Hacienda, which is used for staff housing, still retains its historic significance and integrity, and is considered more appropriate in the long range for interpretation.

In the Stables, where spaces were historically used for shops, it is suggested that it would be appropriate to retain that use to the extent needed. Many spaces, however, are appropriate for interpretation and exhibits.

New seating or picnic areas should not be developed within primary building groups and thus intrude on the historic scene. Picnic tables in close proximity to buildings can cause other problems by attracting birds or animals. Such is thought to be the case with the picnic table that was on the east porch of the Main House. Food remains may have attracted birds, which in turn causes maintenance and curatorial problems as well as an unattractive situation. For these reasons the picnic table has been removed to discourage eating in this location. Additional rest seating of appropriate style could be provided here however.

Seating in the Annex Alcove however is interpretively useful and probably welcomed by visitors. It is also historically correct. However, when possible the historic pieces should be replaced with reproductions. Also those items that are non-historic (those modern items presently in use because they were "available") should be replaced with either historic reproductions or modern seating complimentary to the historic but non-intrusive so that they will blend or "fade into" the

22. Ibid., pg. 52.

23. Ibid., pp. 52-53.

scene but still be apparent as non-historic. The same is true for rest chairs within the building. These need to be unobtrusive but still distinguishable as seating permissible to use.

Interpretive Prospectus

The draft Interpretive Prospectus of February 1989 contains proposals relating to various buildings of the Death Valley Ranch complex. These proposals have ramifications not only on the uses within the Main House and Annex and the other buildings, but also on phasing requirements to achieve restoration work on the buildings which will have to be integrated into the process of achieving any long range building use and interpretive plan.

Although the objectives of the Interpretive Prospectus are desirable, there are some specific proposals which place pressures on available space and affect resource management priorities. Commentary on these aspects is included below. Among the Interpretive Prospectus proposals are, in summary:

Immediate to Near Future:

Gas Tank House: New exhibits

Main House & Annex: Refurnish Central Patio, Garage Alcove, Patio Apartment, and Johnson's Office

Long Range:

Stable: Permanent exhibits, display/sales area, changing exhibits, theater

Gas Tank House: Remove addition, restore, refurnish

Chimes Tower: Restore Deagan carillon system

Hacienda: Restore/refurnish east apartment

Exhibit Niches: Sea Horse Room, Cook House, Chicken Coop, Chime Tower Apartment

Redesign of the exhibits in the "Gas Tank House/Service Station" is a first phase²⁴; then in the long run, removal of the Gospel Foundation's addition to the building and restoration and refurnishing is proposed:

Restore and Refurnish Gas Tank House/Service Station

Remove the wooden 1955 Gospel Foundation addition and restore west exterior elevation of Gas Tank House,...[with proper documentation]. Restore and refurnish Gas House, supported By Historic Furnishings Study as well as the HSR, after the visitor information facilities and media/exhibits are transferred to an alternate exhibit area, such as the

24. Interpretive Prospectus (Draft), Death Valley National Monument, February 1989, pp. 20-21.

historic Stables. Also consider restoring adjacent central patio, if adequate documentation can be developed in the Historic Grounds and Landscape Study.²⁵

Comments. Removal of the Gospel Foundation's addition is desirable, after other space can be set up for exhibits. Refurnishing of the Gas Tank House may not seem necessary for the overall story but the historic equipment is in the collection, and by returning it to the Gas House would free up space where it is stored for other use.

Assuming that "central patio" means the area between the Gas House and the Castle, restoration would not be functionally suitable. Since the historically intended paving was never accomplished, restoration would mean returning to a gravel surface. A hard surface is needed for safe accessibility. It is proposed here that the area be repaved with a system providing the needed hard surface but that has a color and texture that has more the appearance of gravel than the present asphalt paving.

Some of the near future recommendations for the Main House and Annex in the Interpretive Prospectus are:

Additional areas of the Main House complex should be refurnished. These areas are: the Central Patio and Garage Alcove, the two-room corner Patio Apartment, Albert Johnson's Office, and, if not accomplished through structural restoration, the rehabilitation of the fountains in the Living Hall and the Solarium of the Main House.

After refurnishing, the Patio Apartment could be made immediately accessible for public viewing from the open doorway off the unfinished West Garden Courtyard. This refurnished unit combined with the Power House and selected segments of the tunnel system could become the beginning nucleus for the alternate second conducted tour²⁶ [as proposed elsewhere in the Interpretive Prospectus].

Near future and long-range tour proposals:

When additional staff permits, a second conducted tour should be developed which would include: the Chimes Tower, the Power House, selected segments of the tunnels, the Patio Apartment, Mr. Johnson's Office, and walk-in refrigerator/freezer area. [Because of] The limited physical space in the Tower, as well as the value and vulnerability of the chime system and its electronic controls, these tours would have to be greatly restricted in size.²⁷

Regarding the Stable, a long-range proposal:

Following the construction of new maintenance and environmentally controlled collections storage facilities in the Grapevine Developed area, as proposed in the General Management Plan, the existing maintenance shops and collections storage will be moved from the historic stable. The space vacated will allow room for a major interpretive

25. Ibid., pp. 27-28.

26. Ibid., pg. 21.

27. Ibid., pg. 25.

facility, which would enhance the visitor's experience by offering more to see and do while awaiting the main tour.

This interpretive facility should include museum exhibit rooms and spaces as well as a theater for the showing of the full length Death Valley Ranch significance movie developed in Phase I. Should the future development of the site route visitors to and past the historic stable first, this facility would also need to contain orientation exhibits for the entire historic area.

The capacity of this facility's theater should be at least equal to the maximum size of two conducted castle tours.²⁸

Some of the stable should be used to exhibit: [1] pertinent construction plans and documents or their reproductions, such as working drawings and perhaps the rejected Frank Lloyd Wright design proposal; [2] other objects in the collection not installed in furnished rooms or exhibit niches; and [3] large artifacts, particularly the numerous larger artifacts still in original crates...[or] to display and interpret the Castle's extensive historic tack collection.²⁹

Comments. There is also a concept proposed here for the possibility of recreating a scene of a freight dock at the Bonnie Claire railroad station as a way of exhibiting say the crated artifacts. This writers' reaction to this, coupled with some of the other similar proposals, is that this would be too much, especially in light of the fact that space for critical functions is at a premium anyway. There is enough to exhibit here without creating stage sets.

Another use of the exhibit area would be for long-term changing exhibits, perhaps every 5 to 9 months. Such a provision would allow the exhibiting of a greater variety of specimens from their large museum collection.

Finally the open garage area of the Stable should continue to be used to exhibit historic Death Valley Ranch vehicles, in either stabilized or restored condition.³⁰

Additional long-range proposal detail from Interpretive Prospectus:

Rehabilitate Deagan Carillon in Chimes Tower

To aid in the restoration of the historic atmosphere of the grounds of Death Valley Ranch, consideration should be given to rehabilitating the Deagan carillon system in the Chimes Tower.³¹

28. Ibid., pg. 26.

29. Ibid., pg. 27.

30. Ibid., pg. 27.

31. Ibid., pg. 28.

Refurnish Additional Historic Rooms

To help disperse visitor use and increase visitor enjoyment during extended waits for the conducted tours, additional historic rooms could be considered for exhibit as refurnished rooms. These interpretive developments could not happen until current adaptive uses of historic structures [for quarters, storage, offices, concessions, etc.] are moved to alternate locations, such as the Grapevine Developed Area. The prime place for an additional refurnishing exhibit would be the East Apartment on the main level of the Hacienda [Guest House]....

To provide adequate on-site presence by National Park Service protection staff for fire protection and resource security, at least two options exist. The first option would move concessioner employee quarters from the motel units of the historic Garage to the expanded Grapevine developed area, then move the "required occupancy" quarters for protection personnel from the Hacienda to the historic Garage. The second option would establish a 24-hour security patrol operation, thus eliminating the need for adaptive-use quarters in the historic area for even NPS protection staff.³²

Comments. The second option could have serious effects: without twenty-four hour presence on-site of adequate numbers and type of staff, the buildings would need fire suppression systems which would additionally and possibly adversely impact historic fabric. Special fire investigative and suppression procedures are needed for these buildings to prevent unnecessary damage which might occur without specially trained personnel.

It would also be desirable to establish alternate accommodations for library, work and office space for the Castle's curatorial staff, and vacate the three room complex on the first floor of the Main House Annex. The move would allow these rooms to be interpreted, and refurnished if adequate documentation exists, as originally used -- walk-in refrigerator, walk-in freezer, refrigeration plant, and bedroom/storage area. It would also give the Castle's professional curatorial staff greater freedom of movement, unhampered by the schedule of conducted tours of the Main House and Annex.³³

Comments. The documentary archive as well as the artifact collection should ideally remain on-site. Preservation of the resource, which includes the documentary archive and artifact collections as well as the buildings and their exhibited contents, should be the first priority within management objectives. To remove these archival and collections resources from the site creates a potential for loss. However, there is apparently inadequate space to house all the collections properly on-site. Also available space may not be appropriate for adaption to collection storage without adverse impacts on the historic structures. Thus it may be appropriate to develop new off-site facilities for curatorial preservation.

32. Ibid., pg. 28.

33. Ibid., pg. 28.

Other long-range proposals in the Interpretive Prospectus are:

Exhibit Niches

Develop and open several small exhibit niches scattered throughout the grounds to interpret pertinent but secondary parts of the Death Valley Ranch story....

Examples of possible locations and topics for these interpretive vignettes:

Sea Horse Room [located directly below the Solarium in the Main House] -- the uncompleted swimming pool and front-approach landscaping;

Cook House -- the personalities and work of Designer Charles A. MacNeilledge and Architect Martin de Dubovay, Construction Engineer Matt Roy Thompson, and Landscape Architect Dewey Kruckeburg, or perhaps the local Native American cultures using the Castle's large collection of Native American baskets as an exhibit nucleus;

Chicken Coop [in long extension of Garage] -- lifestyles of the construction workers and/or estate staff, logistics, supply and support for Death Valley Ranch;

Chime Tower Apartment -- either the Deagan carillon or chime system, and/or the uncompleted West Courtyard and Grotto and the adjacent Chime Tower Apartment.

In two of the above cases, these exhibits will only be possible when alternate office space is available elsewhere, perhaps in the current motel units of the historic Garage. At present, offices for the Unit Manager, the Administrative Technician, the Maintenance Foreman, and the Castle Interpretive Staff occupies the Cook House, and the Historic Preservation Maintenance Staff has office space in the Sea Horse Room.³⁴

Comments. Again, some of these proposals would impact operational efficiency if certain functions are not retained on-site. Maintenance, curatorial, interpretive and security/protection could be affected. Adequate and appropriate staff is needed to handle minor emergencies and various visitor needs as well as routine management and maintenance. These functions should receive higher priority than additional exhibit space.

The Cook House and Chicken Coop are regarded as having future potential for interpretation. A major portion of the Cook House could be furnished to the early 1950s era because many of its furnishings are in the collection. [Following the unfortunate fire in April 1991, one proposal developed would be to restore the building to the interpretive period. After new space becomes available for office functions, the building then could be furnished with the material in the collection and interpreted.] The historic features of the Chicken Coop still exist and the space is considered to be appropriate for interpretation rather than merely containing exhibits of other aspects of the site.

34. Ibid., pg. 29.

SPACE REQUIREMENTS DURING RESTORATION

A critical space requirement during restoration work, especially for the Main House and Annex but possibly for other structures as well, is temporary storage for furnishings. Since space is already limited, restoration should be accomplished before instituting new interpretive projects. Also, restoration will need to be sequenced on a room by room basis, or in some cases by small section of a building. Protection and climate in temporary storage areas need to be at least as good as furnishings are presently afforded.

On-site workshop spaces are also required (carpenter shop, paint shop, metals shop, etc.), but not in the Main House or Annex.

Since housing for contractor personnel is not available within the monument, and travel time to commercial housing is a minimum of one hour, contracted work will be more costly. Costs would thus be lower if as much work as possible can be accomplished by the park preservation staff. Housing for these people should be retained at Scotty's Castle and/or Grapevine.

RECOMMENDATIONS

Collection Preservation

The most ideal curatorial preservation condition would be to retain the documentary and artifact collections within the Scotty's Castle District, retaining all the resource in its original location. However, there is inadequate on-site space in the historic buildings for integrated and properly climate controlled collection storage. Many spaces in the historic buildings are inappropriate for collection storage because they still retain their historic integrity but are currently being used for storage or other operational functions, which ultimately threatens their preservation. This integrity should not only be preserved, but many of these spaces should be interpreted or viewed by the visitor. A new (conventional above ground) curatorial facility within the historic complex would be a visually unacceptable intrusion. Hence the proposed development of new curatorial facilities at Grapevine to protect the collection in an adequately sized facility with proper climate control that would not impact the historic structures. It is suggested, however, that an option which should be evaluated for a new collection storage facility be a completely underground structure at the Scotty's Castle District. An underground facility would provide more uniform and economical climate control, greater security, immediate access, and would have no visual impact after construction was completed.

Housing

In the long-term, retain housing at Scotty's Castle Unit sufficient for the minimum determined number of personnel to provide twenty-four hour protection and security.

Phased Restoration Program

A phased restoration program integrating incremental installation of climate control equipment is recommended to reduce the space required for temporary storage of furnishings and artifacts as the work progresses. The number of moves and the distance to temporary storage should also be kept to a minimum.

STORM DRAINAGE ASSESSMENT

OBJECTIVE

The purpose of this chapter of the Historic Structure Report is to provide documentation, description, and analysis of the storm drainage conditions immediately around the Main House and Annex and to recommend methods for treatment of deficiencies.

DOCUMENTATION

Storm drainage has not been specifically addressed in previous studies or reports. Flood mitigation at Scotty's Castle is being thoroughly analyzed in several DSC studies from 1985 to the present,³⁵ and will therefore not be included in this report. Information on historical drainage conditions was gathered primarily from construction drawings, historic correspondence, historic photographs, and discussion with the park staff. In general, drainage conditions have changed little since the historic period. The only major exception is in the area east of the buildings which has been paved over thus altering the drainage. This change is discussed in detail below.

DESCRIPTION/ANALYSIS

Following is a description and analysis of drainage at each major portion of the study area. Treatment is also discussed; treatment alternatives are included when there is more than one possible solution to a problem with the recommended alternative listed first. The recommended treatments are summarized at the end of the chapter. Please refer to Fig. 1 for a schematic plan of existing drainage conditions, Fig. 2 for basement and tunnel conditions, and Fig. 3 for a schematic plan of recommended treatment of drainage deficiencies. Also included are photographs of the areas mentioned in this chapter.

Patio Area

The patio between the Main House and the Annex is drained by two drop inlet manholes (D2 and D3 on Figs. 1 and 3) connected by 10-inch pipes. Manhole D2 is about 8 feet deep, but the 10-inch outlet pipe is near the top of the structure resulting in water being stored in the manhole unless it is drained by opening a valve in the nearby tunnel. This valve is at the end of a 2-inch pipe leading from the bottom of the manhole to the tunnel trench drain. The 10-inch pipe leads eventually into the trench drain in the tunnel near the swimming pool. This system drains the patio adequately.

Along the sides of the patio are concrete planter boxes that contain cactuses. There has been some speculation that these boxes are not draining properly after watering or rain and that the excess water may be seeping into the basement; this is further discussed below.

35. Flood Mitigation Study and Environmental Assessment, (Draft), Death Valley Flood Studies, Volume III, Addendum For Scotty's Castle, Death Valley National Monument, California and Nevada, September 1990, United States Department of the Interior, National Park Service.

Historical correspondence indicates that pipe drains were installed in the bottom of the boxes. Following are excerpts from letters between Thompson and Johnson concerning the drains.

Thompson to Johnson, March 6, 1929:

The Indians have been digging out the planting beds in the patio, which is quite a job as it is mostly solid rock. We are using 3" Byers galvanized pipe for drains for these planting pockets, thoroughly tarring same. [Page 2, paragraph 9]

Thompson to Johnson, March 14, 1929:

Drain pipes have been put in under the planting beds in the west half of the patio and are being placed in those in the east half. [Page 3, paragraph 2]

Johnson to Thompson, March 14, 1929:

I noticed your comment about drains for the soil spaces in the patio for planting vines and flowers. I think you said these drains were iron covered with asphalt. I think, in addition, they should be grouted in along their line of travel, as they will be under the patio and very inconvenient to ever take up if they should ever rust out. I would like to put them in in such manner so that they are at least good for my lifetime. I do not know but what by rights I ought to put copper or brass pipe in a place like that. [Page 1, paragraph 3]

Thompson to Johnson, March 21, 1929:

I feel sure that the 3 iron pipe drain for the flower beds, well tarred and embedded in concrete will last indefinitely. [Page 1, paragraph 4.]

Thus, apparently, 3-inch diameter galvanized pipes were installed to drain the planters. And at least some of them were imbedded in concrete. However, the method of connecting the pipes to the concrete boxes is not known. This would be the most likely place for the pipes to have become plugged, if they are plugged. To determine if the drains are plugged would require uprooting the cactuses and removing the soil.

The pipe routes are also not known. There are some pipe terminations visible in drains D2 and D3 that may be these pipes. Otherwise, they are probably plumbed into the same piping system as the floor drains in the basement.

The soil level in the planter boxes is presently about 1 inch higher than the patio surface. This may be resulting in some water from the planters seeping out onto the patio. To correct this situation the soil level in the planter boxes should be lowered to 1/2-inch below the patio by removing material.

Paved Area

East of the Main House and Annex is a paved area surrounding the Wishing Well. Historic photographs show that this area was originally covered only with gravel. It was paved in the early 1960s, according to the park staff. In paving the area, the presence of a tunnel running east-west across the middle and forming a high section complicated the grading plan. The result was

that north of the tunnel a large low spot was formed. Also, at some places the pavement slopes toward the building.

Drains D4, D5 and the related drain pipes as shown on Fig. 1 were added in the early 1970s to correct a problem with rain water ponding in the low spot. But, it has been only partially effective in eliminating the problem. The piping is only 1-1/2 inch diameter which will not carry the water away fast enough during heavy rainfall. This problem is compounded by gravel plugging the drains. Also, it does nothing about the places where the pavement slopes toward the buildings.

This situation has probably contributed to the moderate water damage that can be seen on the bottom of the exterior doors in this area. Other, unseen damage may also be resulting such as wood decay inside the walls. Therefore, the ponding should be eliminated.

The best method would be to remove the existing pavement and replace it with new pavement sloped to the south with no low spots. The question is whether it is possible to slope the pavement adequately and still clear the tunnel.

To answer this question the area was surveyed to determine elevations. Some of the spot elevations found are shown on Figure 1. These elevations are based on arbitrarily assuming the patio to be 10.00 feet elevation, rather than using the elevation above sea level.

In addition to these surface elevations, the depth in the ground to the top of the tunnel was needed. The Park staff provided this information which they previously had determined by drilling a series of holes through the pavement until concrete was encountered.

Based on this data, it appears that the area can be sloped to the south and repaved. This is the recommended solution, graded to the contour lines shown on Figure 3 eliminating drains D4 and D5 and related piping. Elimination of the drains and piping reduces maintenance requirements. Grades at walls, porches, doors and the patio gate should be adjusted, balancing considerations of historic grade, safety and prevention of water intrusion into structural elements.

The pavement should be chip sealed to give it an appearance more similar to the historic gravel surfacing. Paving should be stopped slightly away (four to six inches) from buildings and walls to prevent staining of the stucco. Restoring the area to its historic condition by replacing the pavement with gravel is not recommended because it would not provide for handicapped accessibility nor control dust.

Swimming Pool Area

To the south of the Main House are bushes, a concrete walk, and the uncompleted swimming pool. The concrete walk (the tunnel roof between the pool and house) has pipe penetrations in it originally intended for floor drains. These pipes protrude about 1/2-inch above the concrete; this was to meet the tile which was never installed. Because the pipes protrude, water ponds on the concrete around the pipes when it rains. This water is seeping into the concrete through hairline cracks and contributing to rusting of reinforcing in the concrete. To prevent further damage, the pipes should either be cut off flush with the concrete or broken out of the concrete and lowered. The best method will have to be determined by experimentation. The only drawback of this action is that it will slightly alter the historical appearance.

Along the south side of the Main House is another possible problem. In some areas the soil is not graded away from the building; it is level or even slopes in slightly. There are irrigation pipes in this area to water the bushes; the poor grading may be causing some of the water to seep into the basement or soften the soil under the foundation wall. This situation can easily be solved by raising the grade slightly in the areas indicated on Fig. 3 and by periodic re-grading as needed. Also, a swale should also be added as shown on Fig. 3 to help carry water from the building.

Area West of Castle

To the west of the Main House and Annex is an area where construction was never completed. Some of the ground here has received a bituminous surface treatment, although a layer of soil has since covered it so it is not visible.

To determine the grading in this area a survey was done. Some of the spot elevations calculated are shown on Figure 1. These elevations are based on assuming the patio to be at 10.00 feet. Since there are tunnels in this area some holes were dug to determine the elevation of the top of the tunnels.

The results indicate that grading is irregular with level areas and low spots rather than a continuous grade away from the buildings. Some regrading should therefore be done. The recommended grading plan is shown on Figure 3. It is also recommended that the soil receive a bituminous surface treatment so it will retain this shape, similar to that existing over portions of this area. Grade should be kept several inches below the tile paving of the west porch to reduce water intrusion into the grout under the tile.

At the southwest corner of the Main House is a stairwell that leads to a landing and basement door. The bottom 1/3 of this door is heavily water damaged, apparently from rainwater falling off the roof, striking the landing, and splashing up on the door. The door should be restored and waterproofed, and the drain kept clear.

Hillside

To the north of the Annex is a concrete retaining wall with a hillside rising behind it. There is a swale presently uphill of the west section of the retaining wall that deflects runoff to the west. However, this swale is rough and has brush growing in it and therefore should be cleaned out and regraded. Runoff from the hillside flows directly against the uphill side of the east section of the retaining wall to the east. This area along the wall has had to be cleaned out periodically to remove material eroded from the hillside. This maintenance will have to continue since there is no feasible way to stop the erosion.

Near the middle of the retaining wall is a flat concrete roof over the organ blower room that has some cracks in it. The cracks are probably allowing water to leak into the building. It is recommended that a concrete topping sloped to the north be applied to this surface to improve drainage and moisture control. Cracks should be sealed before the topping is applied. The topping thickness and pitch will be controlled by door sill elevations and other features.

Tunnels

There is a system of concrete utility tunnels originating at the Main House basement, as shown on Fig. 2, the largest of which are adjacent to the uncompleted pool. The tunnels have concrete trenches that carry water from various sources. The presence of this water encourages cockroaches and other pests to inhabit the tunnel. These pests often go into the Main House, creating a nuisance and sometimes causing damage. The Park staff has recently added pipes to contain the most frequent sources of water such as that from the watercourse. Storm runoff from the patio is also routed through the trenches. Since the volume of water from storm runoff is too great to be contained in the pipes, water will still flow around the pipes in the trenches when it rains, but this is too infrequent in a desert environment to sustain the pest population.

Another source of uncontained water in the tunnels are the concrete roof slab drains previously noted. These pipes terminate at the tunnel ceiling and permit rainwater runoff to drop into the tunnel at various points with no provision for containment. This water should be controlled by connecting new drain piping to the existing 3-inch drain penetrations and routing to containment pipes in the trenches. Three-inch piping will be more than adequate for the runoff volume from the collection area.

The only drawback in adding these pipes is that it somewhat alters the historical conditions, but this is more than offset by the need to eliminate pests that could damage the structures and their contents.

Basement

In the Main House basement, water stains are apparent on some of the walls, most notably at two places on the north wall. There has been some speculation by park staff as previously noted that these two stains may be the result of excess water leaking from the planter boxes in the patio area. But at only one of the stains is there a planter box immediately outside the wall. At the other stain there is a stairwell outside the wall indicating that the water is not coming from the ground. The source of this water is not known at this time. It possibly could be coming from the wall space resulting from a leak much higher up in the building, or more likely through cracks in the tile grout in the exterior stairwell.

No one at the park can remember what the conditions were when the stains occurred (such as if it was raining or if the planter boxes had just been watered). If this were known, it could indicate the source of the moisture. Therefore, it is recommended that the park staff begin keeping records of when each of the leaks occur. If they occur during planter watering, then reducing the amount of watering may help. If that is not adequate then the planters should be dug out and have bottom drains added or repaired as needed. They should also be waterproofed by coating the inside with asphalt.

If leaks occur during precipitation an attempt should be made to trace the water to its source so appropriate repairs can be made. If a leak occurs when there has been no precipitation or plant watering, then the source is probably leaking piping and should also be traced to its source so repairs can be made.

Leaks originating higher up in the building are most serious because the moisture may be causing serious structural damage on its way to the basement. Therefore, these leaks should receive the highest priority for repair.

In the central room of the Main House basement, at the location below the northeast corner of the south porch, is a water stain indicating leakage. This was probably caused either by damage to the foundation wall by root pressure from a palm tree, which has been cut down, or from the lack of positive drainage away from the wall. This location should also be monitored to determine if leakage is still active.

TREATMENT

Listed below is a summary of the recommended treatments.

Patio Area

Lower the soil level slightly in the planter boxes. In the longer term, excavate the planter boxes, clean the drains, modifying them if necessary, waterproof the concrete, reinstall the soil and replant.

Paved Area

Regrade and repave the area to drain to the south.

Swimming Pool Area

Cut off or lower drain pipes in the walk (tunnel roof slab).

Do minor regrading on south side of Main House.

Area West of Castle

Regrade the area adding or restoring bituminous surface treatment where appropriate.

Hillside

Clean and regrade the swale.

Apply a topping to the slab over organ blower room.

Tunnels

Pipe overhead drains to the storm drain piping.

Basement

Monitor wall leaks to determine the source, then make appropriate repairs.

RECOMMENDATIONS FOR FUTURE STUDIES

A Historic Landscape Study is needed for proper grounds maintenance. Retention of the Oleanders in front of the Main House for soil stabilization is recommended pending decisions based on such a study.

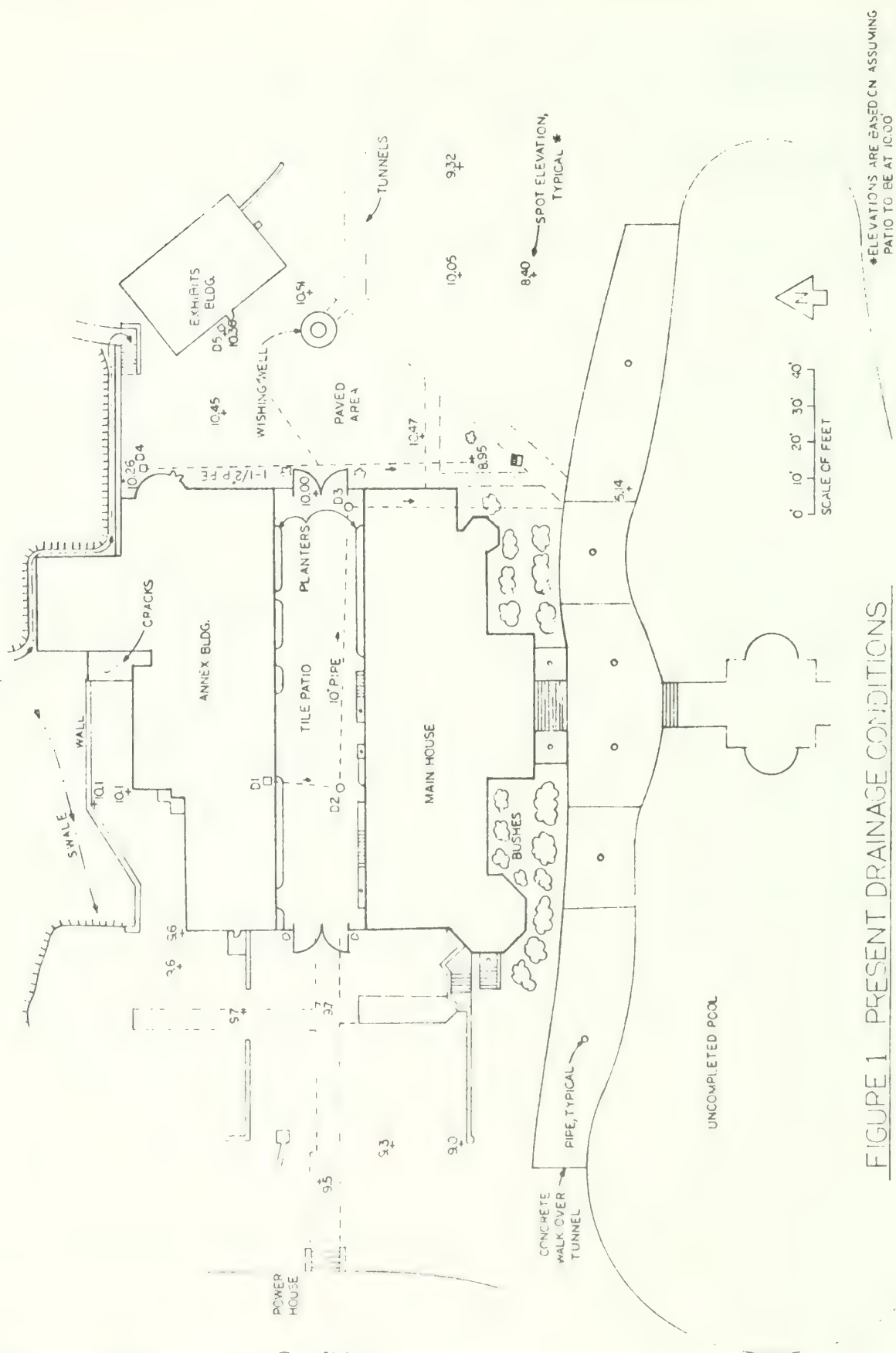


FIGURE 1 PRESENT DRAINAGE CONDITIONS

Figure 1: Present Drainage Conditions

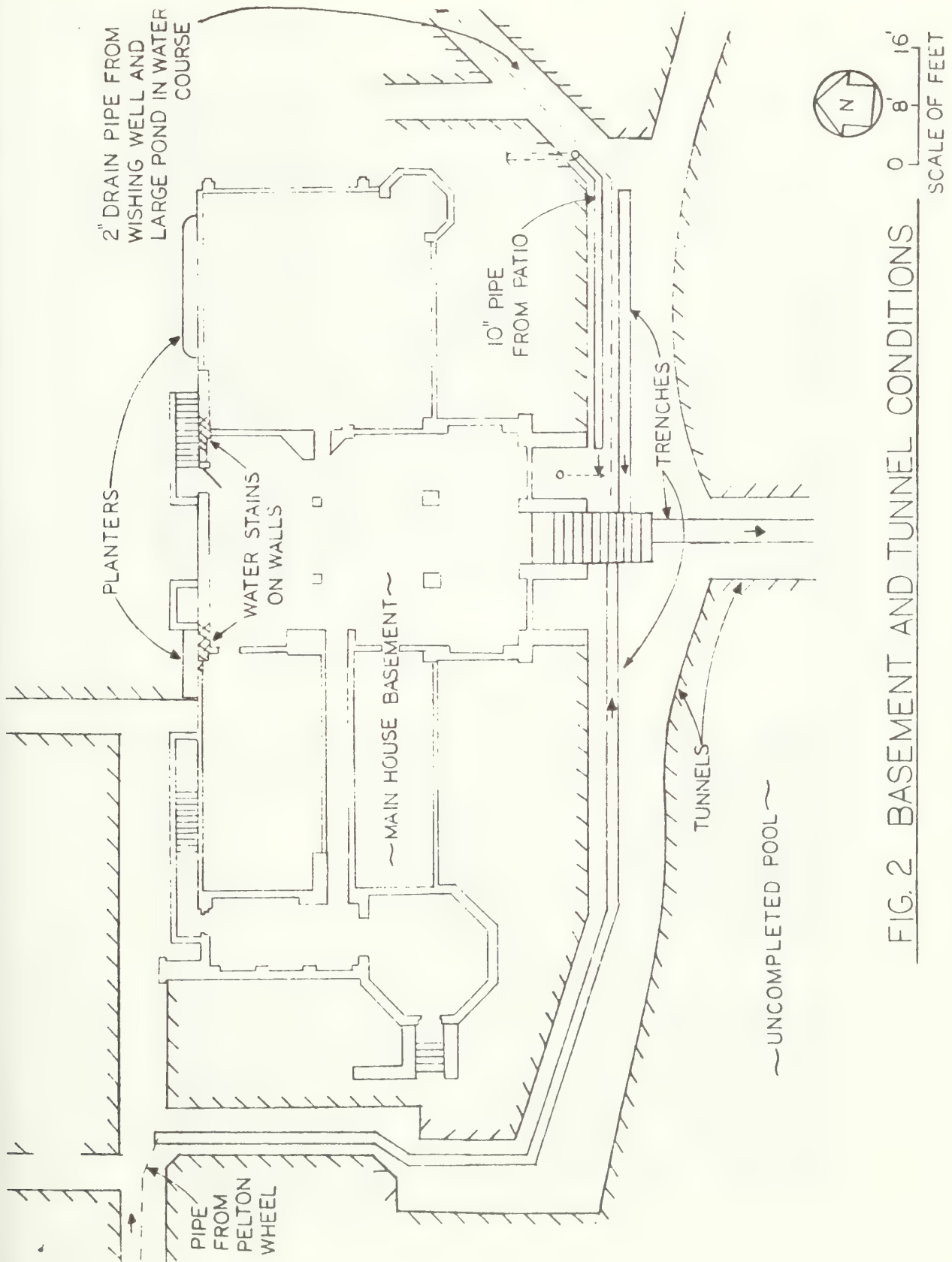


FIG. 2 BASEMENT AND TUNNEL CONDITIONS

Figure 2: Basement and Tunnel Conditions

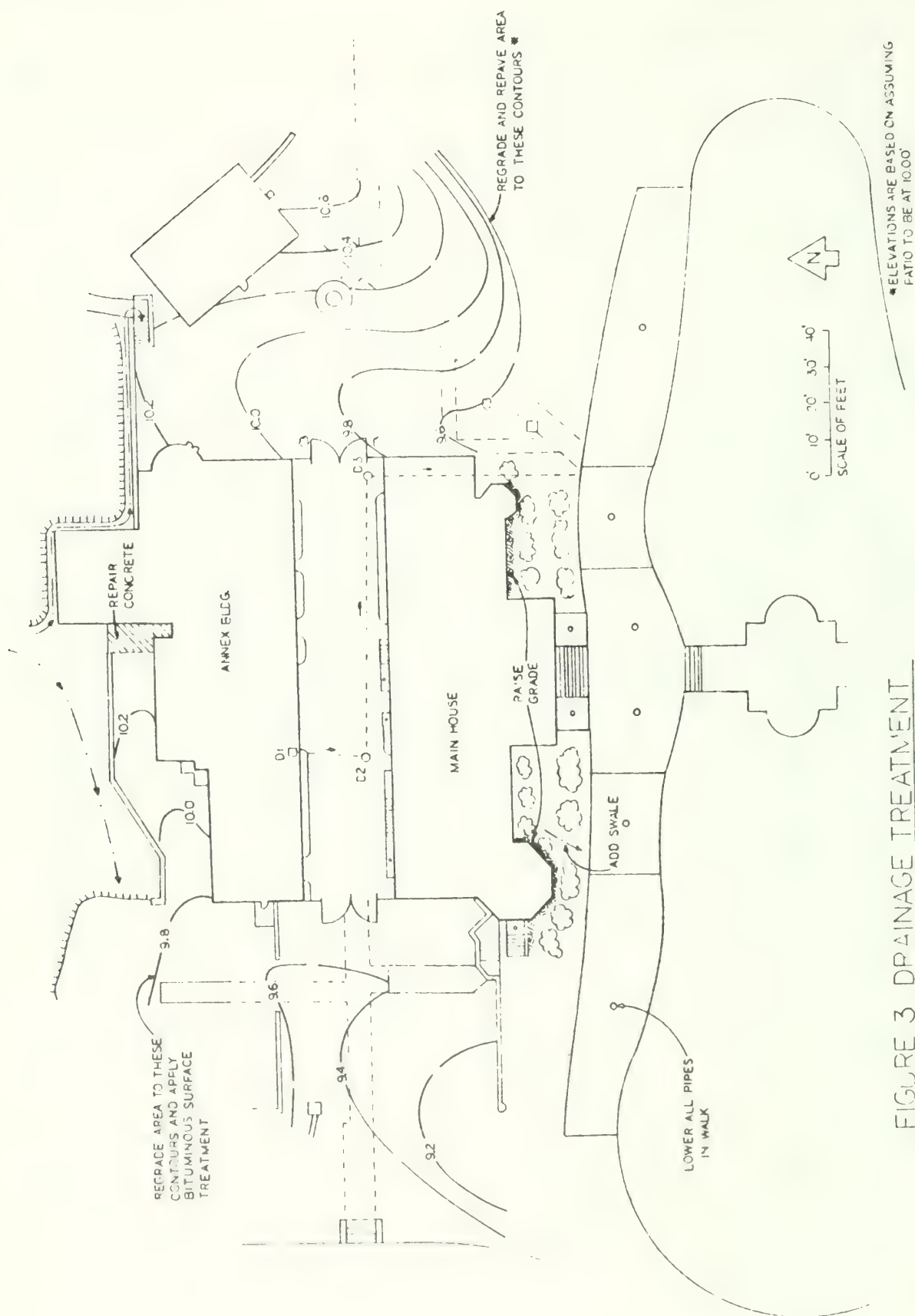


FIGURE 3 DRAINAGE TREATMENT

Figure 3: Drainage Treatment

Storm Drainage Assessment



Photo 1: Patio, looking west.



Photo 2: Hillside, looking southeast.



Photo 3: Area to west of castle, looking south.



Photo 4: Northwest corner of annex, looking east.



Photo 5: Swimming pool area, looking west.



Photo 6: Door at southwest corner of main house.



Photo 7: Tunnel under swimming pool, looking south.



Photo 8: Tunnel between main house and swimming pool, looking east.



Photo 9: Paved area, looking north.



Photo 10: Paved area, looking west.

PEST MANAGEMENT

OBJECTIVE

The objective of this chapter is to assess the background and conditions reported and evident regarding pest problems at Scotty's Castle, document the actions which have been taken in the site pest control program, and present recommended strategies for consideration in the future pest control program.

The Problems

Over the years, various pests have contributed to degradation of the structures and their furnishings. Structural wood has undergone termite attack. Wood of building decorative elements has suffered from the boring of carpenter bees, and mud daubers build their nests on wood surfaces. Powder post beetles have attacked wood furnishings and have undoubtedly attacked wood building components as well.

In the tunnels, open water flow from various sources has attracted insects, particularly cockroaches and silverfish. Some of the water sources are from the creek, the drain from the Pelton wheel generator, the structure drain system, and drainage water from the exterior entering tunnels at historically incomplete construction (such as the east end of the main tunnel).

Other general pests -- mice, packrats, rodents, scorpions, crickets, and spiders gain entry to the buildings and affect furnishings as well as the buildings.

DOCUMENTATION

1. March 17-19, 1982: Inspection for termites by contractor. Inspection report indicates locations found and tagged.
2. September 30, 1984: Background information contained in National Park Service IPM Information Package, Structural Pests I: Termites, Final Report, by Dynamic Corporation, Rockville, Maryland, to U.S. Environmental Protection Agency, Arlington, Virginia, September 30, 1984.

The report includes information and recommendations on:

- Termite IPM Decision Tree
- Biology and ecology of termites
- Termite management
- Sample termite inspection form

Of particular interest are:

- Natural enemies of termites -- pg. 15
- Management Alternatives - Nonchemical, pp. 18-19
- Management Alternatives - Chemical, pg. 20

3. February 22, 1988: Memorandum to Superintendent, DEVA, from IPM Coordinator and Resource Management Specialist, DEVA; IPM Inspection of Scotty's Castle and Proposed IPM Monitoring Plan for DEVA.

Discusses problems of cockroaches, rats and mice and includes recommendations.

Cockroaches -- locations -- tunnels and storage rooms; measures to deny access (habitat modification); eliminate water and food sources; trap/monitor; plan suggests action based on a predetermined "threshold level" beyond which infestation is unacceptable; treatment - recommended with a boric acid derivative; pesticide spraying recommended to be discontinued.

Rats and mice -- recommendations: habitat modification -- deny access; trap for control and monitoring; set "threshold level"; native species do less damage than "old world" types.

4. May 31, 1988: Listing of structures with termite infestation.

5. September 2, 1988: Memorandum to Superintendent, DEVA, from Curator, Scotty's Castle; Analysis of Pest Trapping at Scotty's Castle, 1988.

Discusses results of trapping, monitoring of infestations of cockroaches, mice, packrats, scorpions, crickets, silverfish and spiders.

Monitoring showed that tunnels harbor cockroaches, mice, packrats, scorpions, crickets and silverfish, and possibly other pests. Monitoring began in early 1987. Efforts have been made by the maintenance division to seal cracks and crevices with steel wool and block other openings with wire mesh to keep out rodents.

The memo also notes that "it was shown that cockroaches feed off the rodenticide placed in the tunnels and survive. Not only that but many mice never make it to the outside, entering the walls of the house and decaying. The result of this is to provide a perfect breeding ground for cockroaches."

Gaps under doorways into both the Main House and Annex provide entry for cockroaches, scorpions, spiders and mice.

A test was conducted to determine if the humidity in the house would be reduced if the water in the open courses in the tunnels was to be taken out by pipe instead. In a one month test there was a slight variation but the change was controlled by the humidifiers.

In 1989 drain piping was installed in the tunnels to collect water from the watercourse pond drain and discharge, and the Pelton wheel discharges from the Powerhouse and Main House basement, all of which previously infiltrated the tunnel.

6. October 14, 1988: Memorandum to Superintendent, DEVA, through Chief, Resource Management, from Park IPM Coordinator; Pesticide Use Approval for FY89.

Includes policies, procedures review. Noted offshoot of chemical treatment (rodenticide bait) for rodents -- roaches are not affected -- but dead rodents attract dermestid beetles which in turn attack museum objects.

7. October 27, 1988: Memorandum to Superintendent, DEVA, through Chief, Resource Management, from Park IPM Coordinator; Pesticide Use Approval for FY89.

1988 approval for chemical control of roaches and rats and mice only. Reapply for FY89.

8. October 27, 1988: Memorandum to Park employees from IPM Coordinator; Pest Management.

Note objective (1st para.), monitoring and trapping (2nd para.), action level (3rd para.), regarding roaches, rodents, scorpions and spiders.

9. 1988 [?]: IPM Action Plan, DEVA.

Note discussion on cockroaches, primarily oriented to Scotty's Castle.

10. April 11, 1989: Memorandum to Curator, Scotty's Castle, from Cooperative Extension, University of California.

Positive identification of termites, and general information.

11. April 21, 1989: Memorandum to Exhibit Specialist, Scotty's Castle, from Park IPM Coordinator; WASO Approval of Termiticide Use.

Dursban TC was approved for use on termites.

12. Summer 1989: Photos of termites found outside Hacienda and termite damage at the Cook House.

ANALYSIS

The purpose of this chapter is not to provide a technical analysis of pest characteristics and treatment. The entomology or biology of pests and treatment, especially chemical, are highly specialized areas and are beyond the scope of this report. General background and recommendations are the intent here.

Termites

The 1982 inspection includes reported identification of termite evidence at several locations:

In the Main House, "Below the front steps adjacent to entrance to below ground tunnels, active infestation of subterranean termites were noted, along with structural damage to wood members of a doors [sic] and frame." There were apparently two locations where infestation or damage was found.

"Active infestations of subterranean termites were noted in the tunnels that run below the house and near the house. Termites were infesting wood members and some support posts."

In the Annex "Substructure Area", the report stated "Cellulose debris noted in sub area.... This is conducive [sic] to pest infestation."

The latter location was in the crawl space beneath the Upper Music Room stage. This location was tagged, either in the 1982 inspection or later. An additional problem here is that the wood framing wall sill plates are in contact with or covered with soil.

In the report was also discussion of stucco cracks, noting that one of the potential causes might be the result of termite damage in the wall framing. Such damage weakens the sills and lower ends of wall studs and would cause wall settlement. This type of damage was found in the Cookhouse in 1989 and 1990 when a stucco replacement project was undertaken.

Beetles

The 1982 inspection also reported wood beetle damage:

The furniture in the main house had considerable damage due to powderpost beetle and/or other wood destroying beetles....Some pieces were severely damaged.

More evidence of wood destroying beetles was noted in furniture inside [the Annex]....About 25% of the furniture appears to be damaged.

Cockroaches

Infestations of cockroaches have been a problem over the years at wet or damp locations throughout the complex. In the tunnels, open water courses and ground water seepage were major breeding areas for the insects. Water collection and containment has been accomplished in recent years and has greatly reduced the problem, although this work is incomplete. This is discussed also in the site drainage, structural and concrete sections of this report. Development of control methods will continue to require attention on an on-going basis, particularly at the Snack Bar.

Other Insects and Rodents

The references above have recorded the observances and problems associated with the many other pests, and provide the background on treatment measures which have been undertaken.

Pesticide spraying had been done in past years but discontinued, not only because of toxicity concerns, but also because of the question of potential effect on wood and stucco building materials. (Also see the wood chapter of this report.) Monitoring and control through environment modification is in practice and showing positive results, although problems still exist.

TREATMENT

Recommendations

The following are derived from the referenced material (especially the NPS IPM Information Package of 1984) with suggestions considering the characteristics of the Scotty's Castle structures. Although these recommended practices are based on measures dealing with termites, many

apply to prevention or treatment of infestations of other insects, and are presented in the sense of application to insects in general. Some standard treatments or prevention methods contained in the general IPM documents cannot be used on historic structures, i.e., any treatment action which would adversely impact the historic scene or fabric. Additional information is found in other chapters of this report, particularly that on wood.

1. Conduct annual inspections of all structures for termite damage. Have inspections conducted by an independent entomologist, from the state university or USDA, not by an inspector from a treatment company, to assure unbiased inspections and recommendations.
2. Remove all ground/wood contact.

This has been recommended in other chapters of this report, where examples have been cited, such as in crawl spaces.

In a typical historic construction condition of the stuccoed wood wall system, the exterior stucco finish would normally extend below the level of the wood framing and terminate below grade and below the top of the foundation. Two conditions now exist: (a) grade is above the stucco termination, which may or may not be below the level of the wood wall sill, or (b) grade is below the level of the stucco termination. In either case, there are many cracks and fissures between the stucco and concrete which are potential routes for termites and other insects to gain access to the wood wall framing and wall cavities. While maintaining the historic grade as much as possible, it is recommended that where historic grade is above the level of stucco termination, the termination be repaired where required and the bottom edge and interface with concrete (or other material) be sealed with an asphaltic or other mastic to prevent entry of insects as well as water. Where the stucco termination is above grade (and should remain so) similar treatment should be done but with a sealer that will not be visually intrusive.

3. Maximize drainage and cross-ventilation under structures, and use other techniques to limit moisture in and around structural wood.
4. Remove all cellulosic debris (such as wood and paper) from soil in building area. Remove termite shelter tubes.
5. Where active infestations are found, treat soil around and under foundations. Spot treat sources of infestation, if possible. Find and treat colonies in wood, structures or soil.
6. Avoid excess moisture. Maintain good drainage away from buildings. Repair leaks (roof, plumbing, etc.) immediately.
7. Where wall framing repairs and replacements are necessary, replacement sills or any framing in contact with concrete and which is not visible should be pressure preservative treated (with AZCA or CCA, or other of the lowest toxicity preservatives).
8. Maintain paint coatings on wood surfaces in good condition.
9. Maintain stucco and other materials in good condition, especially at joints and other interfaces such as at windows, doors and other openings to eliminate access points. This serves to prevent intrusion by insects and also water.

10. Screen openings such as attic vents with 20 mesh noncorrosive metal screening. Install screening at the interior side of such openings or in a manner that is not visible.
11. Weatherstripping, especially gaps under doors, will block entry of many insects such as spiders and scorpions. Weatherstripping is also recommended to reduce air, dust and pollutant infiltration as elements of the climate control plan and protection of furnishings.
12. Effective treatment for carpenter bees is difficult. Localized (bore hole chemical treatment) does not prevent the insects from boring new holes. Both localized and general insecticide treatment (spraying) present the potential of harmful effects on wood. Frequent inspection and non-chemical removal should be continued. Plugging of bore holes is needed to reduce reuse by the insects by installing redwood dowels. Select dowel size to fit the hole snugly. Use exterior carpenter's glue (or resorcinol glue) to secure; orient end grain of the dowel parallel to grain in the member. The length of dowels should be pre-sized to eliminate any need to trim or sandpaper its end once installed.
13. There does not seem to be evidence that mud daubers or their nests harm wood. The damage occurs indirectly from removal if not done carefully. Scraping is the most common cause of mechanical damage. Removal without damage to wood can be accomplished by crushing the mud deposit in on itself with finger or cloth then lightly picking up the remaining dust residue with a damp cloth.
14. Follow the IPM Plan for inspections, monitoring and treatment actions -- the IPM tree:
 - Routine inspection
 - Problem identification
 - Monitoring
 - Environmental modification (clean-up, mechanical control, trapping)
 - Chemical treatment -- as a last resort -- only when determined to be necessary; use only approved chemicals.
15. Continue primary consultations with:
 - a. U.S. Department of Agriculture Cooperative Extension Service representative
 - b. State university entomologist

IMPACTS

All actions should be based on and approved IPM Plan tailored for the historic structures. Such approved plan should have no affect on historic resources.

COSTS

Costs of inspections, monitoring and implementation should be programmed as part of the routine maintenance program.

STRUCTURAL ASSESSMENT

OBJECTIVE

The objective of this chapter of the HSR is to document an assessment and analysis of the structural systems and conditions of the Main House and Annex of Scotty's Castle. The purpose of the assessment is to record conditions and identify deficiencies for preservation and corrective treatment. The purpose of the analysis is to determine the appropriate level of treatment and, technically, the best strategy of intervention. The study was undertaken in 1989 by Structural Engineers Richard Silva and Dan Tower.

DOCUMENTATION

Main House

Foundations. The foundation system for the main building is fairly well documented in the original construction drawings (see Drawing 1).³⁶ The main house is supported mainly by concrete walls which are founded on continuous spread footings. Concrete piers are located in the foundation to support posts (timber columns). The posts support the large trusses in the Living Hall roof. There are also square spread footings which support concrete columns which carry part of the first floor slab. The construction drawings indicate that each fireplace is supported by a two foot thick reinforced concrete mat. There are no reinforcement details for the Main House foundation. However, details of the tunnel wall and footing reinforcement indicate that design methods used for the building were state-of-the-art for the time. The foundation system for the Main House does not show any sign of deterioration or failure.

Basement and Tunnels. According to the construction drawings (see Drawing 1)³⁷, the basement floor is a three inch reinforced concrete slab which covers the entire basement area. The main basement walls are reinforced concrete bearing walls which support the first floor slab. The floor slab and walls appear to be in excellent condition.

There are reinforcement details for tunnel sections around the swimming pool area which give a good indication of how the tunnel walls, floors, and roof were constructed. Tunnel walls are supported by continuous reinforced concrete spread footings. The walls, as shown in the drawings, vary in thickness. The typical tunnel section (see Drawing 2)³⁸, which details the tunnel which runs below the swimming pool, shows a 12 inch reinforced concrete wall. Along this tunnel wall an additional 8 inch wall may have been added to help support the pool slab. The construction drawings (see Drawing 3)³⁹ show the north pool wall, which is also the south tunnel wall, to be about 14 inches thick. Measured thicknesses along this wall are closer to 19

36. Historic drawing, Foundation Plan, no date, Drawing No. 143/41029, sheet 4 of 41. All drawings cited in this section were issued by the office of C. A. MacNeilledge unless noted.

37. Ibid.

38. Historic drawing, Swimming pool concrete structural details, April 20, 1929, Drawing No. 143/41035, sheet 14 of 27.

39. Historic drawing, pool and tunnel details, November 1930 [? date difficult to read], Drawing No. 143/41030A, sheet 1 of 4.

inches. The most likely reason for this difference is that there were many changes of plans during construction phases of the job.

The tunnel roof slab between the Main House and the pool is critical because it presently undergoes some traffic loading. The original plans call for a 6 inch reinforced concrete slab with 10 inch by 14 inch concrete beams at 10 feet on center along the tunnel (also see Drawing 3). These beams were never installed, which was also probably due to a change in plan during the construction phase. Measurements taken through the slab at various drain locations vary from 4 inches to 7-1/2 inches while the construction drawings call for a 6 inch reinforced concrete slab.

Correspondence between the project supervisor and Mr. Johnson⁴⁰ mentions that the west end of the patio slab, above the tunnel between the Annex and the Main House, is 8 inches thick and designed for a 1,500 psf load. The tunnel roof, west of the two buildings, reduces to 6 inches thick. The tunnel floor slabs may be anywhere from 6 inches to 8 inches thick with either welded wire fabric or bar reinforcement.

The pool-tunnel walls were placed in sections which created regularly spaced vertical construction joints along the wall. These construction joints have a keyway in the center with 16 gauge copper sheet water stop along each side of the keyway and a 1/4 inch gap between wall panels (see Drawing 4).⁴¹ The gaps are filled with a material referred to as "elastite," which looks similar to standard asphalt expansion joint filler. Construction joints in slabs use the same "elastite" joint filler. There are three locations where tunnels end with timber bulkheads used to retain the earth fill outside the tunnel walls.

Except for a few problem areas, the tunnels appear to be in excellent condition. There is some structural cracking in the roof slab between the pool and the Main House. Visual inspection of the tunnels show varying degrees of water damage (see the Tunnel Layout⁴²). The floor slab between areas D-3 and D-4 has suffered a great deal of scaling damage. There is an indication of water infiltration in this area. Signs of water damage or infiltration are notable in areas G, N, O, R, TT - TT3, and V.

Fairly severe cracking has occurred at areas DD, JJ, and KK. The most severe cracking in the tunnel area occurs at area Q where extensive cracking and spalling is apparent. Tree roots, which have worked their way beneath the base of the wall, are the likely cause of this damage. The trees above this root system have long since been removed. Spalling, which has exposed reinforcement, is found in tunnel walls at areas S, T, and XX. Finally, the brick and mortar at area P and at the brick foundation beneath the Living Hall fountain show moderate deterioration (see Brick chapter).

The timber bulkheads at areas A and U are badly deteriorated and are allowing earth fill to collapse into the tunnel. This may lead to severe structural damage to the Guest House directly above area A if the foundation is undermined.

40. Thompson to Johnson, February 10, 1929. (See excerpt in the Concrete Preservation section of this report).

41. Historic drawing, pool details, November 13, 1930 [?], Drawing No. 143/41030A, sheet 2 of 4.

42. Voyta, George and Creech, Don, "Historic Structures Condition Study", DEVA, 1979-82.

The tunnel which extends under the pool and the tunnel between the pool and the Main House have concrete "trenches" which are set into the floor slab. These 2 feet wide and 3-1/2 feet deep "trenches" are covered with 2x6 planks which are flush with the floor slab. Some of the planks are slightly deteriorated and worn. They are loose and somewhat unstable with many gaps between planks and with several planks missing.

Walls. The Main House, as it now stands, was remodeled around an already existing building and thus the exterior wall framing is somewhat unusual. It is not possible to visually inspect the existing wall framing, therefore information in this chapter is based on the small amount of information available in the construction drawings.

A typical wall section in the Foundation and Footing Plan (see Drawing 5)⁴³ indicates that the exterior walls in the original structure are framed with 2x6 studs, probably at 16 inches on center. The outside face of the framing is covered with a layer of stucco. During the remodeling phase the outside of the exterior walls were furred out with 3 inch thick, 12 inch square tiles which were attached to the framing with metal ties. A 2 inch void between the framed wall and the furring tiles was then filled with "insulex", a powdery substance that, when mixed with water, expands and transforms into a rigid, foam-like, insulation. The exterior face of the furring tiles was then covered with stucco and the interior face of the wall assembly plastered. Total wall thickness is about 12 inches. The Solarium, which was added during the remodeling phase, is constructed in the same manner (see Drawing 6).⁴⁴

The interior wall framing was evidently added during remodeling. It appears that standard construction techniques were used and that interior walls are framed with either 2x4 or 2x6 studs which are probably laid out at 16 inches on center. Most of the interior walls act as bearing walls which carry roof and floor loads to the foundation. [Insulex was installed in at least some of the interior walls, particularly those around bathrooms.]

The interior walls appear to be structurally sound. There is no sign of any excessive movement. There is some slight cracking in the upstairs bathrooms which does not appear to be structurally related.

The exterior walls are in generally good condition. There are, however, signs of possible structural stress in the east wall of the Main House. A significant amount of cracking runs from the south end of the porch roof to the bottom center of the south window and then from the top, left corner of the window to the roof. There is another crack directly above the right side of the south window just below the roof line. The majority of these cracks are visible only on the exterior face of the walls, with a few small cracks on the interior face. There is some less severe stucco cracking in the north wall, where the north porch wall ties into the Main House. For more information on stucco conditions refer to the stucco portion of this report.

43. Historic drawing, Footing and Foundation Plan, August [?], 1925 or 1926 [?], Drawing No. 143/41029A, sheet 2 of 9.

44. Historic drawing, Solarium Details, October 14, 1927 or 1929 [?], Drawing No. 143/41029, sheet 16 of 41.

First Floor. The first floor (see Drawings 7, 9, 10, & 11)⁴⁵ is constructed of a reinforced concrete slab. The slab thickness is probably 6 inches, the same thickness as the three porch slabs. The extent of the reinforcement is not known. The slab is supported by a combination of columns and bearing walls. The first and second floor wall loads are carried directly to the foundation. The floor loads, therefore, consist primarily of the floor tile, the furniture (which is rarely moved), the slab itself, and the tour groups which generally have consisted of about 26 people in recent years.

On the first floor, near the entrances to the Dining Room and the Lower Music Room from the Living Hall, there is some slight cracking in the tile floor. There are no other indications of any structural problem with the first floor. Visual inspection of the floor surface and the basement ceiling reveals no other cracking. There is also little, if any, noticeable motion in the floor when it is walked on.

Second Floor. The second floor (see Drawings 8, 9, 10, & 11)⁴⁶ is a framed structure which, except for the north and south galleries above the Living Hall area, appears to be constructed with 2x8s. Notes in the construction drawings indicate that, during the remodeling phase, two additional floor joists were added between the existing joists, probably to support the heavy tile floor. The Gallery floor framing around the Living Hall area is exposed on the north and south sides, consisting of three 6x6 redwood beams which run longitudinally from end to end. The beams are supported with four evenly spaced redwood brackets. The east and west ends of the Gallery are probably framed with 2x8s at from 12 to 16 inches on center and supported by bearing walls from the first floor.

As is the case with the first floor framing, the second floor wall loads are directly transferred to the foundation. The loads carried by the second floor are once again the floor tile, the furniture, the bathtubs in each bathroom, the floor framing, the first floor ceiling, and the tour groups.

The second floor also appears to be in excellent condition. Visual inspection of the second floor framing, through plumbing accesses behind the bathtubs, shows the framing members to be in excellent condition with no sign of deterioration. Several of the exposed redwood ceiling members in the Dining Room have split. However, after several years of monitoring and the provision of humidity using portable humidifiers, the splitting has not worsened.

Roof. The roof, as with the rest of the Main House, was remodeled and is well documented in the construction drawings (see Drawing 12).⁴⁷ The original roof was a relatively flat, framed structure. The new roof appears to be fairly well built and was apparently designed to support the heavy tile roofing and the exposed beams and purlins in the second floor ceiling below.

45. Historic drawings: First Floor Plan, Main House, December 8, 1926, Drawing No. 143/41029, sheet 6 of 41; Longitudinal Section, Main House, December 17[?], 1926, Drawing No. 143/41029B, sheet 6 of 36; Sections, Main House, August 1, 1926, Drawing No. 143/41029A, sheet 9 of 9; Main House Section and Details, December 10, 1926, Drawing No. 143/41029B, sheet 7 of 36. Some details were not built as shown on the last two sheets, including the Living Hall roof.

46. Historic drawing, Second Floor Plan, Main House, [date not readable], Drawing No. 143/41029C, sheet 4 of [?]; and Ibid.

47. Historic drawing, Main House details, [date not readable], Drawing No. 143/41029, sheet 31 of 41. This drawing shows the roof framing as it was constructed.

The original lower roofs appear to be built with 2x10 rafters which span from the outside wall to a center bearing wall. These rafters in turn support the ceiling below. To support the remodeled roof, the center bearing wall was extended up to carry the new rafters. The roof is constructed with 2x8 rafters spaced at 16 inches on center and braced in the middle by a 2x8 brace at every other rafter.

The Living Hall roof (see Drawing 13)⁴⁸ is supported by the exposed redwood trusses. These trusses are built with 10x12 top and bottom chords and 8x10 bracing. The bottom chord is spliced in the middle with a keyed and mortised joint and with bolted splice plates top and bottom. [In the original construction, the top splice member was mistakenly installed as two pieces, interrupted by the vertical king post. The joint thus does not function with the strength that it would have had if constructed correctly.] These trusses are evenly spaced at about 10 feet on center and support 6x6 redwood purlins which run the length of the room at 18 inches on center. Exposed 1x8 sheathing is laid across the purlins. The newer roof was built above this visible truss system.

The newer roof (see Drawing 12) is built with 2x8 rafters at 16 inches on center supported by the outside wall and girder trusses at the ridge and halfway between the ridge and the wall. The girder trusses are built with double 2x8s for the top and bottom chords and 2x8 bracing. There are 2x6 ties which connect the wall to the center truss and the center truss to the ridge. The girder trusses are supported by the exposed Living Hall trusses below. The Living Hall trusses are supported by columns in the wall which carry the roof load directly to the foundation.

In the 1970s it was noticed that the Living Hall trusses were beginning to show signs of impending failure. The bolts which held the bottom and top chords together were bending over and a 2x4 wedge in the bottom chord splice was beginning to shear in half. A large sag was also measured in each truss. At that time, a reinforcement system designed by Maurice Paul, a structural engineer with the Denver Service Center, was installed. This system consists of large tension rods attached to brackets which are bolted on each side of the bottom chord splice. Also, the failing bolts at the bottom to top chord connection were supplemented with much larger bolts. Since then, monitoring gauges show no indication of movement.

The octagonal shaped Solarium roof (see Drawing 6) is framed with 6x6 redwood joists which meet at a center hub and are supported at the walls by redwood 6x8 beams. Beneath the beams are redwood brackets; whether these are structural as well as decorative or purely decorative is not indicated on the historic drawings. The roof load is carried entirely by the outer walls. The Solarium roof shows no sign of structural defects.

Stairways. There are two sets of stairways in the Main House (see Drawings 9 & 11). One leads from the first floor to the second floor and one leads from the second floor to the Observation Tower. The first to second floor stairway is framed conventionally with 4-2x10 stringers running from the first floor to a second floor header. The stairway which runs to the Observation Tower (see Drawing 14)⁴⁹ is somewhat unusual. The 1-1/2 inch thick wood treads are supported by 4 inch steel channel stringers on each side. The stringers are supported by the floor at the bottom

48. Historic drawing, Great Hall Trusses, July 27, 1926, Drawing No. 143/41029, sheet 21 of 41. (The roof was not built as shown on this drawing, however.)

49. Historic drawing, Main House Observation Tower details, February 15, 1927, Drawing No. 143/41029, sheet 10 of 41.

and by braced posts at the top. The posts rest on top of one of the purlins in the main roof structure.

The first to second floor stairway stringer supports show signs of deterioration and the connections appear to be somewhat inadequate at the bottom of the stair. The Observation Tower stairway is only supported at the top and bottom and is not connected to the adjacent walls. Otherwise this stairway appears to be in excellent condition.

Veranda. The Veranda deck appears to be a reinforced concrete slab, probably 6 inches thick, placed on top of the porch ceiling below (see Drawing 10). The porch ceiling is constructed with either 6x6 or 6x8 exposed redwood joists at 2 feet on center and covered with wood sheathing. The joists are supported by the front porch walls and the house walls.

The Veranda roof is constructed with sheathing on top of 2x6 redwood joists laid flat. The joists are supported by five pipes which are 1-1/2 to 2 inches in diameter. The pipes run along the bottom of the joists, and are held in place by clamps lag bolted to the 2x6s. The joists are supported by ornamental pipe "posts" at the outer wall. The roof sheathing overhangs about three feet past the outer joist at each end of the roof.

The Veranda floor deck appears to be in good condition. The roof structure is the only area of concern. Because the roof cantilevers three feet past the last joist, the outer edges of the roof began to deflect excessively. To prevent the roof ends from deflecting, temporary supports were installed. These supports are loose and somewhat unstable. Also, some of the lag bolts which hold the clamps in place are coming or have come loose due to deterioration of the redwood around them and wind induced movement.

Balconies. There are two second floor balconies on the south side of the main building, one outside Mrs. Johnson's Room and the other outside the Spanish Sitting Room, which measure about 3 feet by 10 feet. Beneath these balconies are ornamental wood brackets attached to the wall below. It could not be determined whether these brackets are structural as well as decorative.

The balconies do not appear to be structurally sound. There are two problems. First, the timber members are exposed to the weather without any protection and appear to have weathered extensively. Second, the balconies show signs of minor displacement. It is difficult to determine from construction drawings or visual inspection whether the displacement was originally built in so the balconies would drain or if the displacement is due to long term creep of the wooden members or strain at connections.

Other Exterior Features. There are a few areas of concern outside the Main House. First, there are signs of soil settlement and/or erosion adjacent to the building along the wall foundation and along some concrete slabs which may contribute to water infiltration into the building structure. Second, there is one window well, adjacent to the porch, which is covered by planks. These planks are poorly supported and unattached, are deteriorating, and are unsafe. Finally, the concrete stair railing (wall) caps at the front porch area are deteriorating.

Annex

Foundation. The structural history of the Annex building is not as well documented as the Main House. The foundation plan for the Music Room (see Drawing 15)⁵⁰ area indicates that the Annex foundation is similar to that of the Main House. From the foundation plan it is apparent that the Annex is founded on reinforced concrete spread footings and walls. The footings are generally 1 foot 6 inches wide and the walls are 1 foot thick. The extent of reinforcement is not indicated in the drawings. The foundation for the Flag Tower is a spread footing which tapers from 1 foot 6 inches at the top to 4 feet at the bottom at an angle of 60 degrees.

It is not possible to directly examine the foundation system, however there is no indication of any major problems. Minor cracking in the exterior Annex walls may be an indication of some slight differential settlement.

Walls. (See Drawings 16, 17, 18, & 19).⁵¹ All first floor walls in the annex are reinforced concrete bearing walls. Second floor exterior walls in the Annex are constructed in much the same way as the Main House. The walls are framed with 2x6 studs at 16 inches on center with 3/8-inch celotex on each side.⁵² A 3 inch layer of "insulex" is sandwiched between the stud wall and a wall of 3 inch terra cotta furring tiles. Plaster and stucco finishes bring the total wall thickness to 14 inches. The second floor interior walls are primarily 2x6s at 16 inches on center with a plaster finish on each side. The walls in the first floor Refrigeration room are lined with a layer of cork substrate.

The interior walls show no sign of any structural problems. There are some large cracks in the Refrigeration and Freezer Room walls which are probably caused by shrinkage or compression of the cork substrate which line the walls, and probably moisture intrusion. The exterior walls have a few areas where cracking has occurred, however there are many areas where the stucco is delaminating from the walls and it is difficult to determine the structural condition of these areas. The most significant cracking, which is possibly structurally related, is at the east end of the building. Other inter-related possible causes are moisture and changes in the building framing systems (see Stucco and Annex Second Floor Deck Chapters).

There are small vertical cracks which extend upward from the center of each archway in the east wall of the east porch. These cracks appear on each face of the wall and across the top of the arches. There is a moderate crack in the east wall extending vertically from the top right corner of the pipe chase opening toward the entrance bell. This crack coincides with the intersection of the south wall of the Annex and the east porch wall. There is also a crack along the inside corner where these two walls intersect. These cracks are most likely due to the change of framing systems and materials at this intersection.

50. Historic drawing, Upper Music Room Foundation Plan, December 31, 1927, Drawing No. 143/41031, sheet 99 of 159.

51. Historic drawings: Annex Elevations, 1927 [?], Drawing No. 143/41029, sheet 28 of 41; Annex Plan and Elevation, First Floor, October 28, 1926, Drawing No. 143/41029, sheet 38 of 41, an M. R. Thompson drawing; Annex, Second Floor Plan and Sections, [no date or illegible], Drawing No. 143/41029, sheet 26 of 41; Upper Music Room Floor Plan, December 31, 1927, Drawing No. 143/41031, sheet 104 of 159.

52. Shown on Drawing 143/41029, sheet 26 of 41. The use of the Celotex in the original construction has not been verified.

There is a vertical crack in the Flag Tower wall where the east porch wall ties into the Tower wall. This crack is visible along each face of the wall. Another vertical crack appears in the east Annex wall, under the porch ceiling, where the wall ties into the Flag Tower wall. Although very small, another crack appears in the tile floor above the porch ceiling at the inside corner where the Tower wall and the Annex wall meet. Finally, large horizontal cracks appear in the Annex north wall behind the Flag Tower, in the north wall at the far west end of the building, and along the east end of the south wall. All of these cracks are on the outside face of the building opposite concrete decks which tie into the wall.

First Floor. There is no available information regarding the first floor. The entire first floor is definitely a reinforced concrete slab. The slab thickness and the extent of reinforcement is not known. The Refrigeration Room floor is constructed with a cork substrate between the concrete topping and the main floor slab.

There are two problem areas in the first floor. First, where the patio slab slopes up to the garage area, the paving tiles have heaved. The sloped transition between the patio and garage floor was intended; however, the upward displacement of the tiles which have separated from the substrate may have been caused by lack of an expansion joint in the tile paving or between the concrete slabs and building components or both. Second, the Refrigeration and Freezer Room floors have settled as much as 1-1/4 inches, probably from compression of the cork substrate. The remainder of the first floor appears to be in good condition.

Second Floor. The second floor (see Drawing 17) is a wood framed floor built on top of a reinforced concrete slab. This slab is supported by bearing walls and, over the open garage area, by 18-inch by 18-inch reinforced concrete beams. The second floor is actually a split level with the Music Room being 10 inches below the bedroom area and about 12 inches above the exterior floor slab (see Drawing 20).⁵³

The western portion of the second floor is framed with 2x8 joists at 16 inches on center. The joists are supported by beams which are held up by 4x4 timber posts which bear on the concrete slab. In the bathroom, each end of the bathtub is supported by a 4x4, which runs parallel to the joists. The 4x4s are supported by 1x6s which span between two joists.

According to the construction drawings (see Drawing 20, the Music Room floor is framed with 2x8s which lay directly on the concrete slab. This subfloor supports a reinforced concrete slab and tile finished floor with a total thickness of 5 inches. The orchestra floor is framed with 2x10 joists at 16 inches on center which bear on the lower floor (Music Room floor) at one end and on a wood stud bearing wall on a concrete footing at the other end. The orchestra floor is 12 inches higher than the Music Room floor.

The Organ Chamber floor, which is directly behind the Orchestra area, is 4 feet below the orchestra floor. From information in the construction drawings, it appears that there is a reinforced concrete slab, below the main slab, which supports this floor. The elevation of this slab is 1 foot lower than the Organ Chamber floor, therefore the Organ Chamber floor is probably built on 2x8 or 2x10 joists supported by the slab.

The second floor does not appear to have any major structural flaws. There has been some subsidence around the bathtub and in the Music Room. The bathtub has pulled away from the

53. Historic drawing, Upper Music Room cross section, November 15, 1927, Drawing No. 143/41031, sheet 98 of 159.

wall tile and there is a gap which measures up to 1/2 inch wide. Similarly, there is a gap between the Orchestra floor tile and the tile base along the Organ Chamber partition. This gap also measures as much as 1/2 an inch. The settlement around the bathtub is probably caused by the undersized 1x6 supports for the heavy bathtub. It was not possible to inspect all of the framing in the Music Room but the settlement may also be due to undersized members to support the piano or, more likely, a combination of settlement, wood shrinkage and termite damage.

Roof. The Music Room roof system (see Drawing 21)⁵⁴ is difficult to describe. It consists of 5 main trusses, one at each end of the room and three in the middle, at about 9 feet on center. There are then 5 rafters at 16 inches on center between each truss. The roof is a combination of structural and architectural systems. The rafters and truss top chords are, effectively, 6x8s (see Drawing 20). The three interior trusses have a bottom chord which is a 1-1/4 inch square, twisted rod which is fastened to the outside of each wall with nuts and 8-inch square, 5/8-inch thick washers. The framing members support a layer of sheathing, 2x4 inch furring laid on edge at 2 feet on center perpendicular to the rafters, 4 inches of insulux, another layer of sheathing, and the roof tiles.

The roof over the center portion of the Annex (see Drawing 18), above the bathroom and two guest bedrooms, is framed with 3x6 trusses at about 2 feet 6 inches on center. These trusses are supported by bearing walls on each end. The partition between the bedrooms and hall is the main bearing wall for these trusses. The roof above the hallway is supported by 3x6 rafters which span from the interior bearing wall to the exterior wall.

The Italian Room roof (see Drawings 18 & 22)⁵⁵ is an exposed roof system. The rafters are framed at 3 feet on center with 6x6 redwood members for the top chords, bottom chords, and braces. There are also three vertical steel tension rods in each truss bolted from the bottom chord to the top chord. The west end of the roof structure is a standard hip roof at the northwest corner of the building and a fan shaped hip with a large overhang at the southwest corner. The hip rafters in the fan are connected at their hub by a 1/4-inch thick steel plate bolted to each rafter. The end of each rafter is supported by 4x6 braces framed into the exterior wall. There is also an overhang which runs along the south wall which is supported by a timber beam and timber columns.

The roof structure for the Annex appears to be well designed and constructed. There are no apparent structural problems in the roof structure. The exposed roof members show no sign of splitting, cracking, or movement.

Other Exterior Features. The north side of the Annex is protected by large, buttressed retaining walls. These walls are approximately twenty feet high and show no sign of movement or deterioration. The concrete deck outside the Guest Bedroom (Bokhara Room) has suffered a great deal of water damage. The deck has experienced a large amount of scaling and also has some exposed reinforcement. The concrete water spout mounted on the east wall has come loose and is supported by a piece of reinforcement tied from the spout to the wall. The remaining areas around the Annex appear to be in good condition.

54. Historic drawing, Longitudinal Section, Upper Music Room, December 31, 1927, Drawing No. 143/41031, sheet 61 of 159.

55. See previous citation for drawing 18; historic drawing 22 is of details of the corner bay of the Italian Room, dated in 1927, Drawing No. 143/41029, sheet 3 of 41.

Flag Tower

The Flag Tower (see Drawings 23, 24, & 25)⁵⁶ is a 47 foot high, cylindrically shaped, reinforced concrete structure. The lower section of the Tower has an inside diameter of 12 feet with a wall thickness of 18 inches at the base and tapering to 12 inches at the top. The 6 inch batter is taken completely in the outside face of the wall, the inside face is plumb. As mentioned before, the Tower is founded on a spread footing. The extent of reinforcement in the Tower walls is not known.

There is a concrete floor slab 32 feet off the ground. This slab projects about 1 foot beyond the exterior tower wall. Around the outer edge of the slab there is a 2 foot high concrete parapet wall. The parapet wall is supported by ornamental brackets spaced evenly around the exterior wall. On top of the slab there is a 14-1/2 foot tall tower with a 9 foot inside diameter and 12-inch thick walls. The historic drawings indicate that this uppermost portion of the tower is a stuccoed wood frame structure.

Access to the upper floor is gained by a spiral stairway which winds around the inside of the tower. The stairs are cast in place, reinforced concrete and are connected to the tower wall by dowels which were cast into the tower wall at the time the wall was constructed. The stairs cantilever out from the tower wall 3 feet. The stair risers measure 6 inches and the treads measure 15 inches. The treads and risers are 6 inches thick. There is an ornamental metal railing with balusters spaced at 15 inches on center and anchor bolted along the outside edge of the stairway. There is a landing at the top of the stairway which supports permanent steel steps that lead to the upper floor slab. From the upper floor slab there are rungs anchored into the exterior tower wall which lead to the top of the tower.

The Flag Tower is in good shape, but there are a few structurally related problems. As is mentioned in the chapter covering walls, there is a vertical crack near the bottom of the Flag Tower which coincides with the porch wall that ties into the tower wall. Secondly, there are large bolts through each edge of the stair landing at the top of the stairway. There is some concrete cracking around the bolt at the northeast corner of the landing. Third, the rungs in the upper tower wall are loose. Finally, there is spalled concrete and stucco at the door and hinges of the Flag Tower concrete door.

The Bridge

There is a footbridge which connects the upper floors of the Main House and the Annex (see Drawing 26).⁵⁷ This bridge has a stucco and tile finish around its structural frame. The bridge is supported with two 8x14 timber beams which span between the two buildings. Spanning between the two beams are 2x6 floor joists at 16 inches on center and connected with steel joist hangers. The floor joists are covered with 1x6 sheathing. A 3-inch thick, concrete slab reinforced with wire mesh covers the floor framing. The 30-inch high handrails are framed with 2x6 studs and 8x8 posts and finished with tile and stucco.

56. Historic drawings: Upper Music Room Elevation and Details, no date, Drawing No. 143/41031, sheet 92 of 159; Upper Music Room Tower, no date, Drawing No. 143/41031, sheet 101 of 159; Flag Tower Details, no date, Drawing No. 143/41031, 103 of 159.

57. Historic drawing, Bridge, 1927, Drawing No. 143/41029, sheet 27 of 41.

The arched lower portion of the bridge is all a facade built with 2x6s and lathe and covered with a stucco finish. The border around the arch that looks like stone is actually thickened stucco (the "travertine" stucco finish).

The bridge has suffered some fairly significant cracking over the years. The most significant crack is at the outer east face at the north end of the bridge where an approximately 4 inch by 2 inch piece of stucco has come loose. The crack runs from the bottom of the bridge, up the inside corner where the bridge and wall intersect, to a point about 12 inches below the top of the bridge deck. The crack then runs across the face of the bridge at a 45 degree angle to a point level with the top of the concrete slab. It then runs horizontally for about 6 feet. This crack is 1/4 to 1/2 an inch wide. On the outer west face of the bridge there is a long, horizontal crack which also is level with the top of the concrete slab. Above this crack, in the handrail, there is another crack which runs from the top of the tiled opening to the 8x8 bridge post. This crack appears in each face of the handrail wall. At the southwest end of the bridge, where the bridge intersects the concrete stairway from the patio, there is another piece of stucco breaking loose which is about 4 inches square. At the inside of the railings the tile paving and tile base have separated and grout is missing, a source for water intrusion into the structure (see Tile chapter).

ANALYSIS

Main House

Basement and Tunnels. There is some cracking in the tunnel roof between the pool and the Main House. The cause of this cracking can probably be attributed to a combination of things. The most common cause of minor cracking in concrete slabs is from shrinkage. This may be the case here. There has also been water infiltration through expansion joints which may contribute to the problem. Where concrete has spalled away enough to expose some reinforcement it can be seen that the reinforcement at that location has only 1/2-inch of cover. This amount of cover is inadequate and may also aid in the cracking. Finally, maintenance vehicles have driven over this area in the past. This slab was probably not intended for any vehicular traffic and may have deflected under heavy loading which might have also contributed to the problem. A calculation of the slab loading capacity, found in the Appendix, shows that the slab may be able to handle about 245 pounds per square foot (psf). However, these calculations use many assumptions and could have some error. The area should be limited to a vehicle weight and payload of 6000 pounds or less.

As mentioned in the documentation discussion, there are several areas throughout the tunnel which give an indication of varying levels of water damage. These areas include areas D-3 to D-4, G, N, O, R, TT to TT3, and V. There are indications of water infiltration at or near these locations. This water may be entering through expansion joints, cracks, or tunnel openings.

Some severe cracking and spalling has occurred at area Q. This damage is directly attributed to the root system of trees which had been planted in the ground above. These trees have long since been removed and no further damage has occurred. Most of the other concrete damage can be attributed to poor construction, water infiltration, and/or concrete shrinkage. The brick and mortar deterioration, especially beneath the fountain, can be attributed to water damage and age. Because the fountain is no longer in use, the rate of deterioration at this location has slowed considerably. None of the other problem areas appear to be worsening.

The deterioration of the timber bulkheads can also be attributed to water damage. The bulkheads at the Hacienda and at the east end of the tunnel between the Main House and swimming pool are in locations that allow moisture penetration of the soil. Over the years these bulkheads have deteriorated badly.

Walls. The slight cracking in the interior bathroom walls is not a structural problem. This cracking appears to be a problem with the plaster or its finish coating and is probably caused by the cycle of humidity and drying inherent with a bathroom.

As mentioned in the documentation discussion, there is some fairly severe cracking in the east exterior wall above the porch. The cracks are most severe on the exterior face of the wall. There is also some slight cracking in the inside face. The exact cause of this cracking is difficult to determine, however it can most likely be attributed to some type of movement in the structure. This movement and resulting damage is a result of settlement and construction material shrinkage, and from the cumulative lateral forces due to wind, earthquakes, nuclear testing, and sonic booms. It is notable that most of the structurally related cracking in both the Main House and in the Annex is located at the east ends of the two buildings.

While there can only be speculation as to the cause of the cracking in the building walls, monitoring of the problem areas should be expanded to note whether the problems are getting worse. Since the mid 1970s, when monitoring began, there has been no change in any of the problem areas.

First Floor. The slight cracking of the floor tile in the Living Hall floor is probably not structurally related. For a discussion of this problem, refer to the Tile Study.

Second Floor. There are no apparent structural problems with the second floor. To determine allowable floor loads for the Main House and Annex an analysis, shown in the Appendix, was performed on the second floor Gallery. Both the Gallery and the Bridge were analyzed because, by their nature, they obviously have the lowest loading capacity of any of the floor systems in the two buildings. The allowable floor live load for the Gallery is determined to be 75 psf. The Bridge capacity is lower than the Gallery and will control in determining the size of any groups that tour Scotty's Castle. The Bridge analysis is shown in this chapter.

Roof. Since the reinforcement of the Living Hall truss there have been no problems with any part of the roof structure. There is some concern about the large load carried by the roof structure. However, an analysis of the roof structure, shown in the Appendix, indicates that the roof is adequate for the applied loads. But it must be noted that if any additional loads are ever planned, including workers on the roof, mechanical systems, etc. the structure may need to be reinforced.

Stairway. The stringers for the first to second floor stairway show some signs of deterioration. Also, the connection for one of the support beams has deteriorated. The deterioration to the stringers and the connection appears to have been caused by water damage. The water source was the fountain which is adjacent to the stairway. This fountain is no longer in use and the deterioration has therefore stopped.

Veranda Roof. The clamp connections which hold the pipe frame and joists together have slowly worked loose. A wind load analysis of the veranda, shown in Appendix, estimates an uplift force of approximately 720 lbs. during extreme conditions. Given the size of lag bolts (1/2 inch diameter) holding the clamps in place and the age of the lumber, this force is large enough to

loosen the connections over a long period of time. Also, as the outermost connections loosen, additional force is applied to the next connection. Therefore, it is certain that wind uplift loading is the cause of the loosened clamp connections for the Veranda roof.

The sagging overhangs are caused by the unsupported weight of the roof structure. The framing members are too undersized to support the three foot cantilever that exists. Without additional support this problem will worsen over time. The temporary supports now in place are sufficient to prevent further sag until a more permanent solution can be implemented.

Balconies. Visual inspection of the balconies shows a great deal of deterioration of the wood as well as minor displacement of the structures. The deterioration is directly due to the age and the unprotected condition of the wood. The displacement of the balcony is most likely due to inadequate connection of the balcony supports framing (see Drawing No. 143/41029, entitled "Balcony Windows", Main House, dated January 11, 1927, a copy of which is included in the wood chapter of this report).

Other Exterior Features. The soil abatement problem is primarily due to negative drainage patterns around the building and the plant watering that was done over the years. Drainage problems are discussed in the drainage analysis chapter. Since watering has been curtailed the problem has slowed. The deterioration of the planks which cover the window well is a direct cause of age and weathering. The concrete stair wall caps have also showed a great deal of deterioration. The cause of this is probably a combination of weathering and poor material at the time of construction.

Annex

Walls. As mentioned in the documentation discussion, the large scale cracking in the Refrigeration and Freezer Rooms appears to have been caused by either shrinkage or compression of the cork substrates which lines the walls and floors of these two rooms, or from moisture intrusion. There does not appear to be any structural problems with these walls.

The problems mentioned with the exterior walls are similar to those in the Main House. The causes of these problems are most likely the same for both buildings. For a discussion of them refer to the analysis of the Main House walls in this chapter.

First Floor. As with the walls, the cause of settlement in the Refrigerator and Freezer Room floors is most likely because of the cork substrate which lines the floors and moisture intrusion. Over time this substrate has either settled or compressed. As mentioned in the documentation discussion, the tile paving across the opening of the alcove has heaved.

Second Floor. Inspection of the framing beneath the tub reveals that a poor method of support was used. The bathtub, which is quite heavy, is supported by a 1x6 at each end. This 1x6 has deflected which has caused the gap around the tub.

The most likely possibilities for the settlement of the Orchestra floor are a combination of wood shrinkage, building settlement and possibly termite damage.

Other Exterior Features. The severe scaling of the concrete slab outside the Guest Bedroom has been caused by water which drains off the roof above during wet weather. The loose water spout fixture at the east end of the building has apparently been loose for a long time. It is held

in place with a section of old, square reinforcing bar. This fixture was probably not set properly at the time of construction.

Flag Tower

The vertical crack in the interior Flag Tower wall is similar to other cracking in the building walls. Differential movement between the Flag Tower and the connecting Annex wall has probably led to this cracking. This problem was discussed in the analysis of the Main House walls. The cracks in the stair landing, around the bolts which anchor the metal stair to the landing, are most likely caused by the lack of clear distance between the face of the concrete and the bolt. The problem could have been compounded if the stairs were used before the concrete was completely set.

The rungs of the exterior tower ladder, which are loose, have probably gotten that way from use over the years. Finally, the cracks around the hinges of the concrete door at the top of the Tower are most likely due to the enormous weight of the door. Moisture intrusion into these cracks aggravates this failure.

The Bridge

An analysis of the beams which support the bridge, (Appendix), indicates that the beams are large enough to support the bridge weight, or dead load, plus an additional safe live load capacity of 25 pounds per square foot uniform loading, or a 923 pound concentrated load placed upon any space 2-1/2 feet square, or a maximum of 19 people. The 25 psf allowable live load is smaller than any allowable loads found in the Uniform Building Code. The cracks which have developed in the bridge have been caused by a cumulative combination of movement from foot traffic and lateral loading caused by both natural and man-made seismic activity and wind. Using photographs taken in 1976, the early 1980s, and during the recent on-site investigation, a comparison indicates very little change has taken place. The size of the stucco cracks has not increased or the length has not progressed significantly.

TREATMENT

Tunnel and Basement

The tunnel roof between the pool and the Main House may fail under heavy vehicular traffic and should be limited to a vehicle weight and payload of 6000 pounds or less. This would allow small cars and lightly loaded small pick-up trucks to travel over the roof slab. The vehicles should not be allowed to park over the roof slab. This loading restriction should not affect normal operations at the castle and would still allow for materials to be transported over the roof slab.

To prevent vehicles from entering the area lockable removable bollards or some other type of barrier could be installed in areas which would be visually acceptable.

Timbers at the window well next to the porch on the south side of the Main House are not secure or well supported, and are deteriorated and should be replaced. The timbers form part of the roof of the basement tunnels and can be walked on from above. The timbers could

eventually collapse under a superimposed load. The existing timbers could be replaced with treated wood timbers, a precast concrete slab, or a cast-in-place concrete slab. Presently, the existing timbers do not provide a watertight seal and entry into the Main House can be gained by prying off the timbers. Replacement with treated timbers would not prevent water from entering into the tunnels and additional anchors would be required. Replacing the timbers with a precast concrete slab would provide more of a watertight seal than the timbers, but still not completely watertight. The cast-in-place slab would provide a permanent watertight seal. The advantage with the precast slab is it can be removed.

The expansion joint material in the tunnel roof slabs and walls should be removed and replaced with new expansion joints and a waterproof sealant.

Although the spalled and deteriorated concrete surfaces and exposed reinforcement is not a serious problem at this time, the exfoliated steel should be treated and missing or deteriorated concrete should be repaired with a cementitious material.

The brick and mortar deterioration beneath the fountain should be consolidated or sealed and repaired to prevent further deterioration (see Brick chapter).

Permanently seal the tunnel ends by removing the heavy timbers and any soil that sloughs into the tunnel and replace with a pre-cast or cast-in-place concrete wall.

Replace board planking over the concrete trenches in the tunnels with galvanized metal grating or plate. The grating would allow for visual inspection of the trench, while the metal plate would conceal the trench like the board planking. If the additional cost is not warranted or the materials are unacceptable, simply replace the damaged planks.

Flag Tower

The loose rungs at the Flag Tower are unsafe and have no abrasive surface to prevent slippage of footing. The existing rungs should be properly re-anchored and an abrasive coating should be applied to the rungs.

The actual climb on the existing rungs is less than 12 feet, but there exists the potential for a fall of 32 feet or more. To prevent a fall a safety climb system or cage should be installed. The safety climb system would be less visually obtrusive than a cage. The system consists of a pole which would be attached to the Flag Tower and a harness which is worn by the person climbing and attached to the pole. The harness allows the person to climb and descend, but clamps around the pole during any sudden movement to prevent a fall. The harness could be stored in the Flag Tower.

Exterior Features

Add a topping slab to the concrete deck and slab outside of the Guest Bedroom.

Apply a sealant to the exterior concrete deck to prevent further deterioration, cracking, and moisture penetration. It should be noted that the sealant could alter the concrete color and paths may be worn on the concrete surface in heavily traveled areas.

The abated soil around the exterior slabs and foundation walls should be replaced with native soils and graded to provide for positive drainage away from the building.

Veranda Roof

The Veranda Roof is in need of restructuring. Using the existing pipe supports, decking, etc., a second layer of wood decking could be added on top of the existing decking. This would require removing the existing roofing material and replacing it after the installation of the new decking. The new decking would be designed for the cantilever at each end and would provide solid connections for both the existing supports and roofing. The overall roof thickness would be increased by the thickness of the decking and the temporary supports at each end could be removed. Another alternative would be to install additional supports at each end of the Veranda roof and additional connections along the wall and underside of the roof. This would alter the original construction of the Veranda by eliminating the cantilevered ends, although temporary supports already exist next to the building at each end of the Veranda and these temporary supports would be replaced with permanent supports. Another alternative considered was consolidant treatment of the wood deck system. This is only a partial solution and would not provide long-term preservation nor the needed structural strength for the entire system. Replacement would be the preferred alternative, with the supports refinished, the roofing and visible under-deck replaced in-kind, and the internal elements redesigned for greater strength.

Bridge

The bridge structure has been over the years has been somewhat overloaded by the size of the tour groups. The bridge is not designed to allow large groups of people to linger on it. It is recommended that if tour groups of greater than 19 people are given, that the tour group be divided into groups not to exceed 19 before proceeding across the bridge.⁵⁸ The recommended safe live load capacity is 25 pounds per square foot uniform loading, or a maximum of a 920 pound concentrated load placed upon any space 2-1/2 feet square.

General

A few minor concrete cracks exist that should be repaired by epoxy injection. The cracks along the concrete door and hinge connections at the Flag Tower and the cracked concrete at the connection of the steel stairs to the concrete landing at the Flag Tower should be repaired.

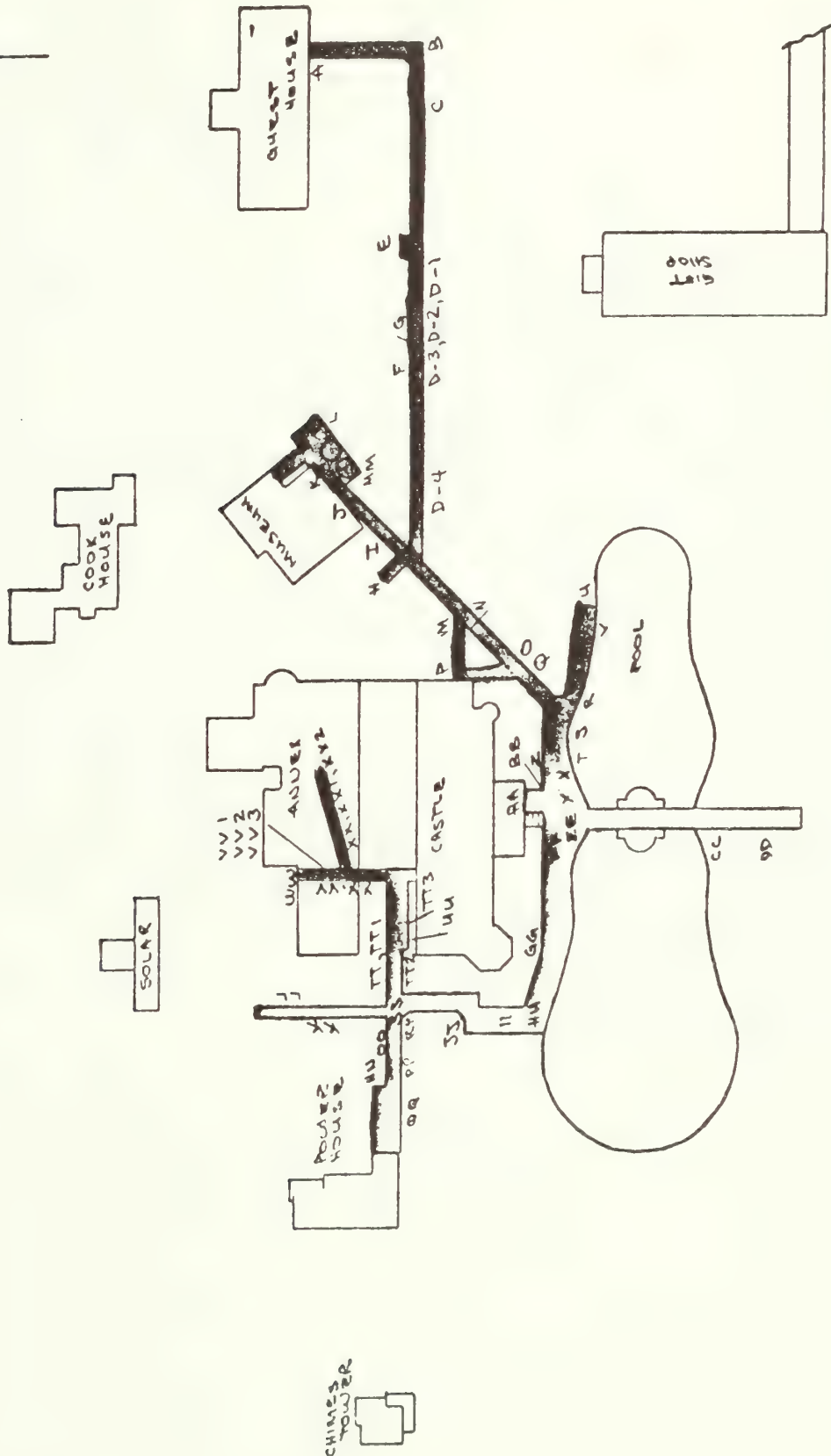
The wall and floor cracks in the Freezer Room can be repaired by surface patching as long as the cork substrate is sound. Where plaster and cork substrate has failed, the assembly needs to be replaced.

The deficient stair stringer support beam and connection from the first to the second floor in the Main House should be repaired.

58. See Memorandum to Regional Director, Western Region, from Manager, Western Team, Denver Service Center, December 20, 1989, included in the appendixes to this section. The recommended load limit of 19 persons was adopted and put in practice in 1990.

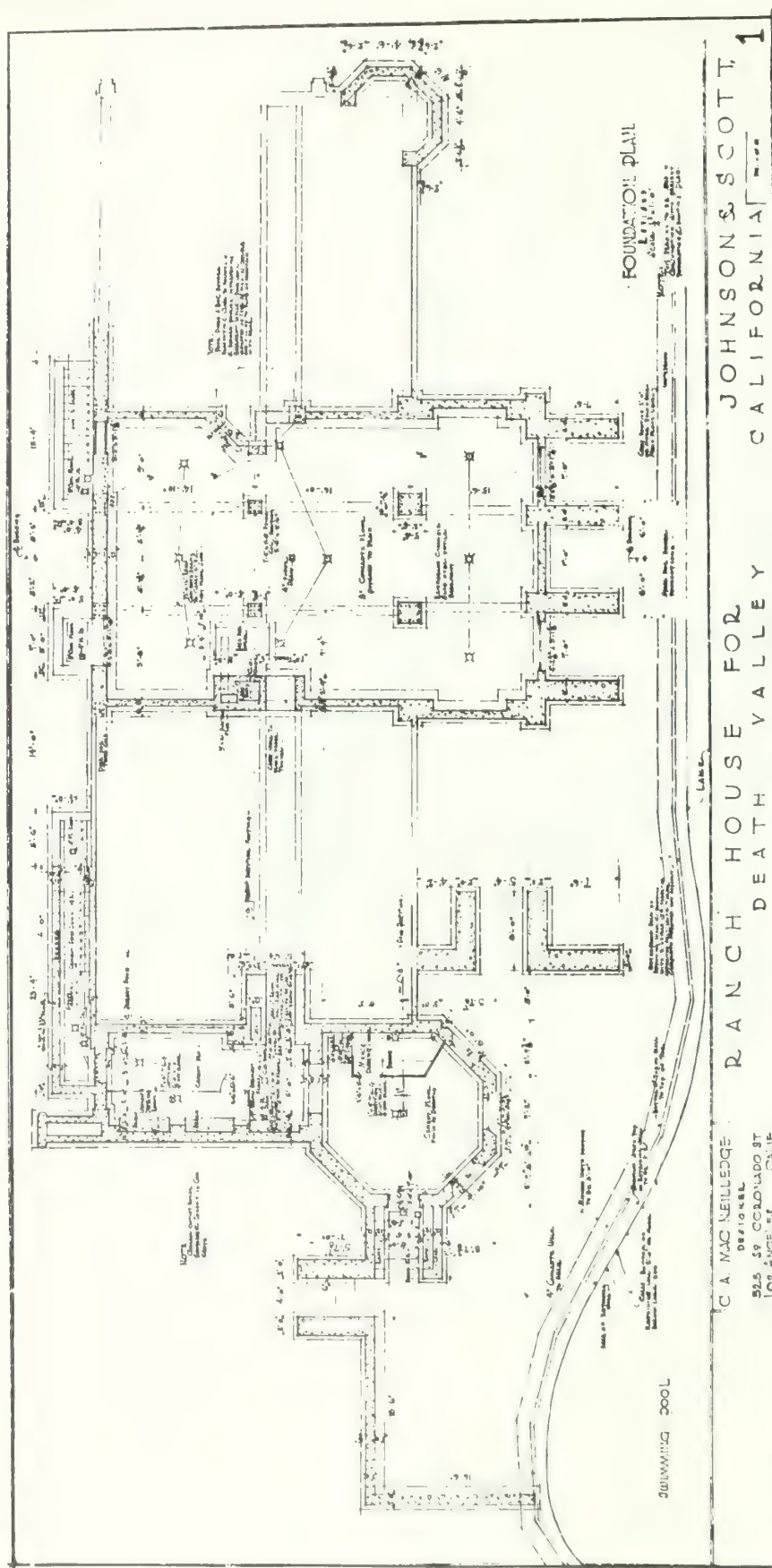
All exposed wooden decks should be sealed with a water repellent sealant, which again may alter the color of the wood.

Some items are best left untreated. For instance, (a) the deteriorated concrete stair railing caps along the porch steps of the Main House, (b) the absence of anchorage along the adjacent walls of the stairs leading to the Observation Tower, and (c) some of the stucco cracks (See Stucco Assessment).

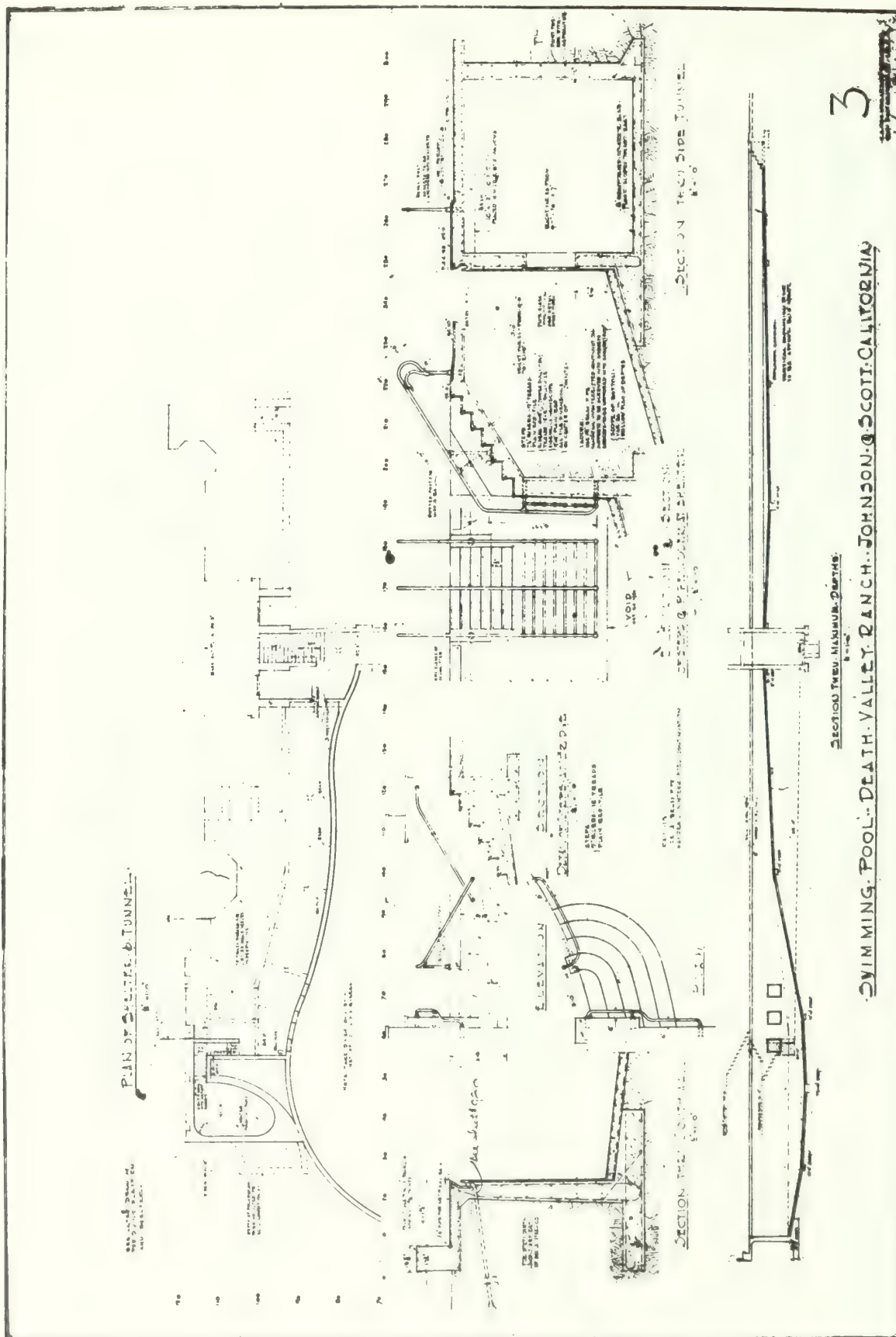


SCOTTYS CASTLE TUNNELS

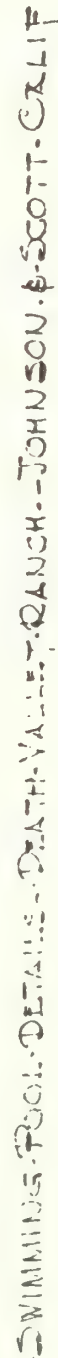
Figure 1: Scotty's Castle Tunnels



Historic Drawing 1: Foundation Plan



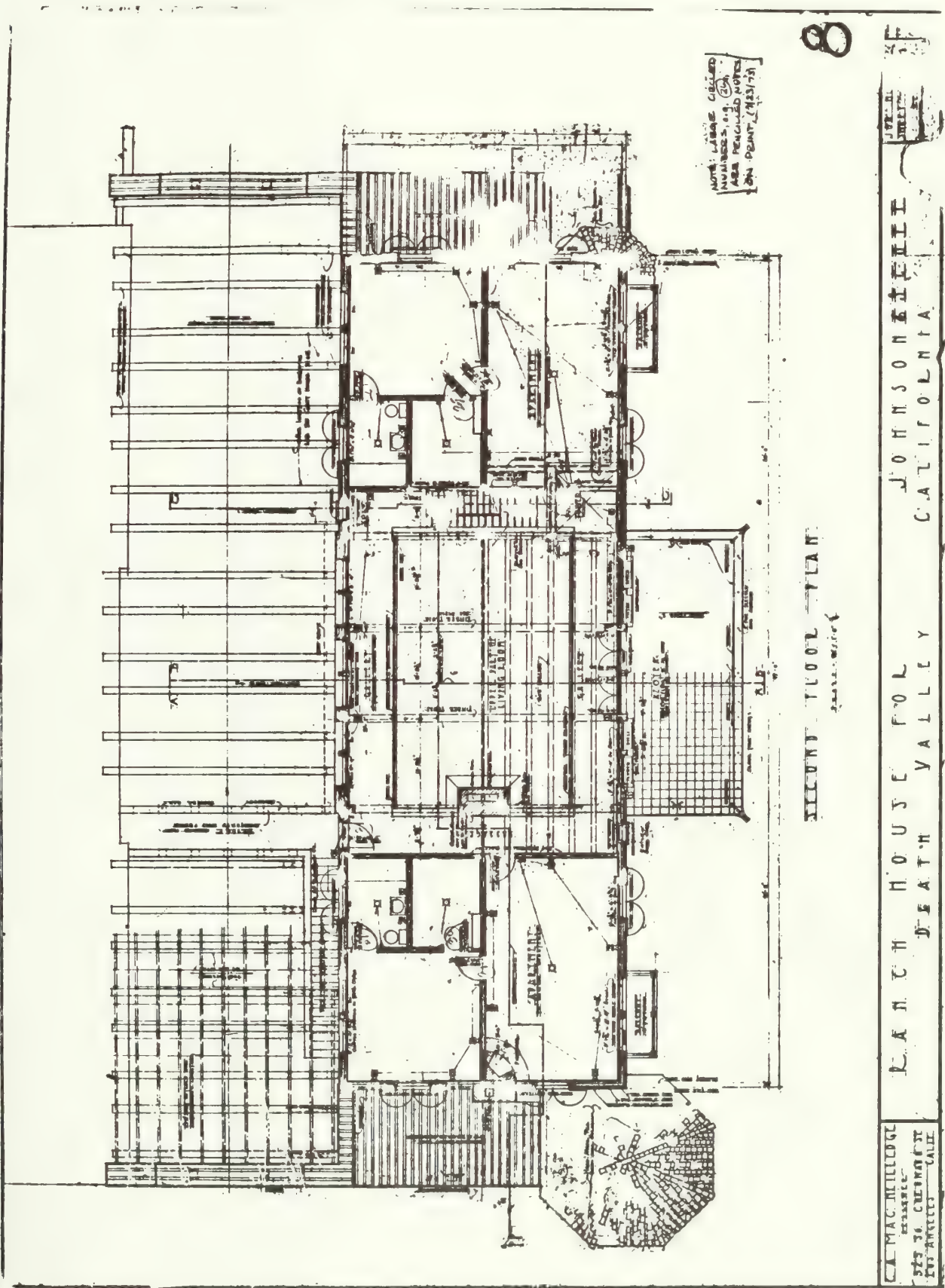
Historic Drawing 3: Pool and Tunnel Details





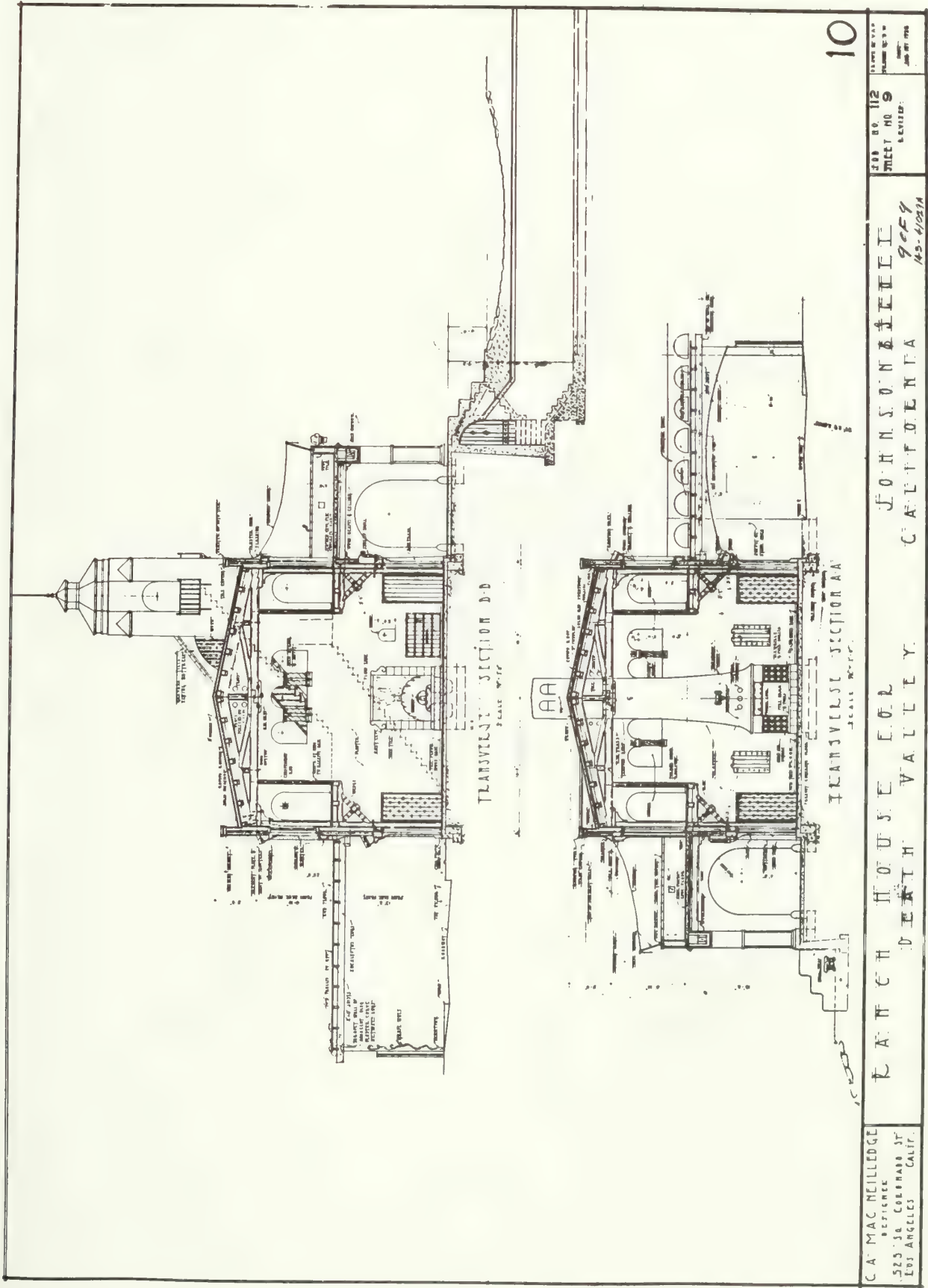
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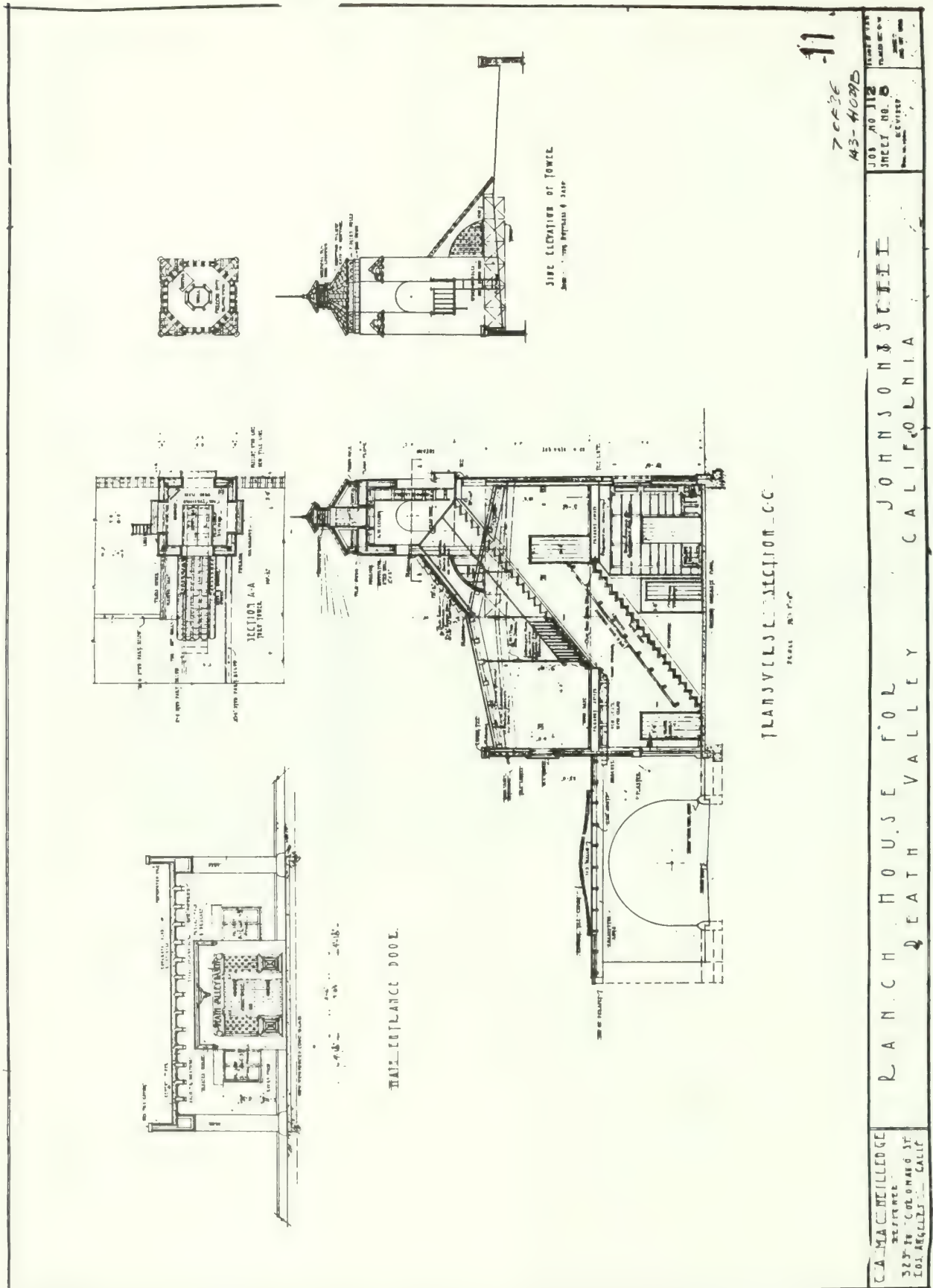


Historic Drawing 8: Second Floor Plan, Main House

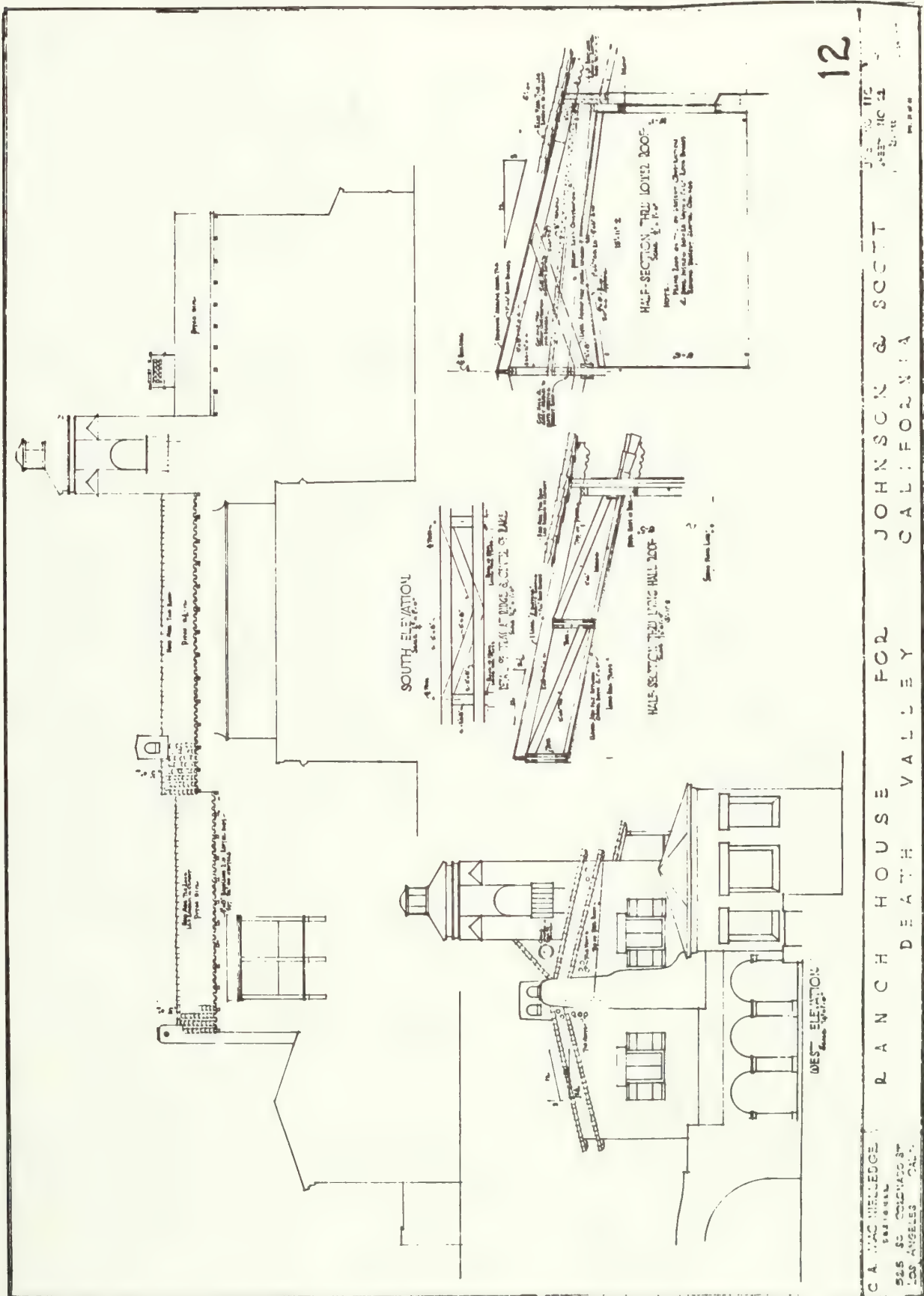




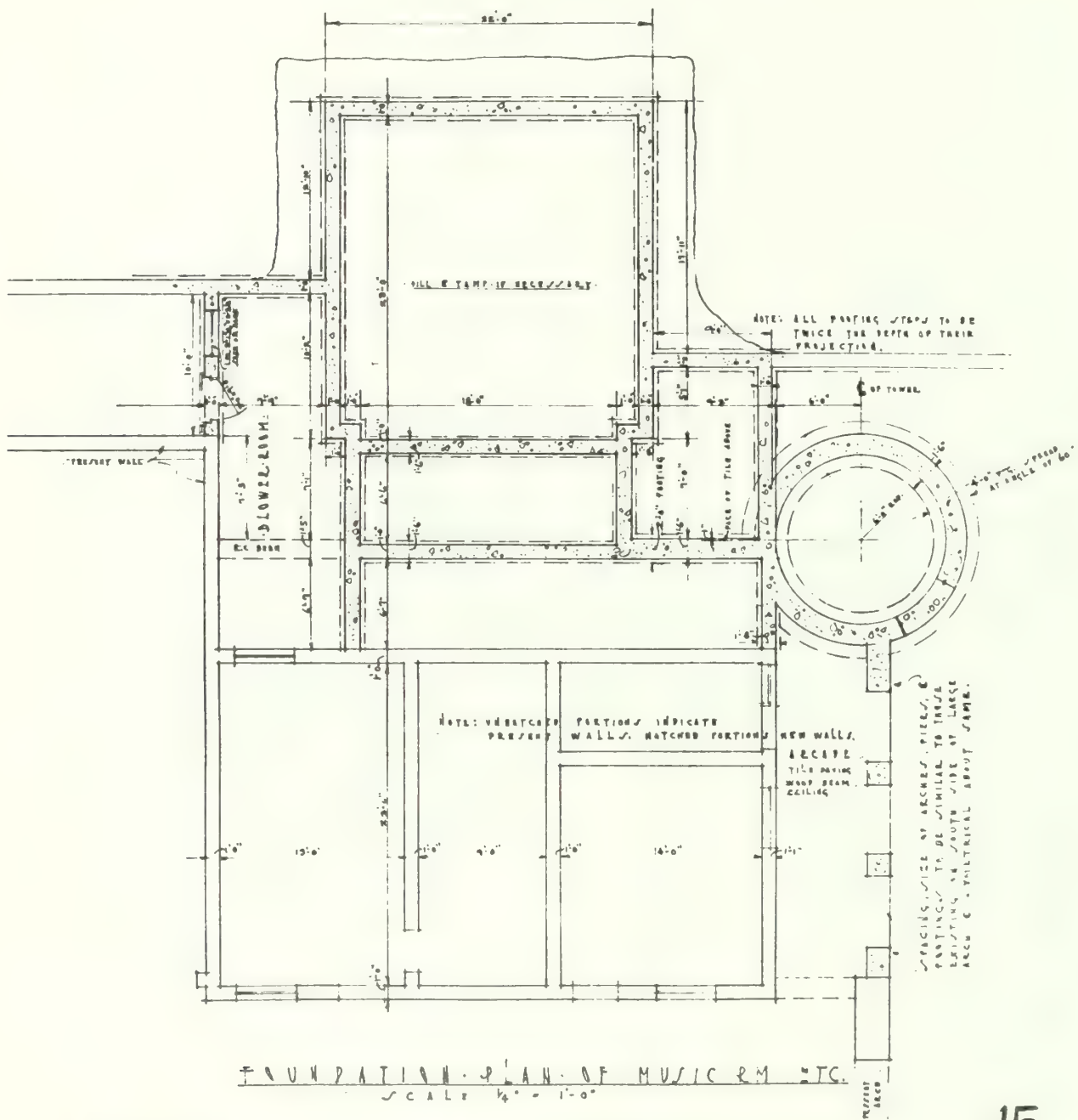
Historic Drawing 10: Sections, Main House



Historic Drawing 11: Main House Section and Details



Historic Drawing 12: Main House Details



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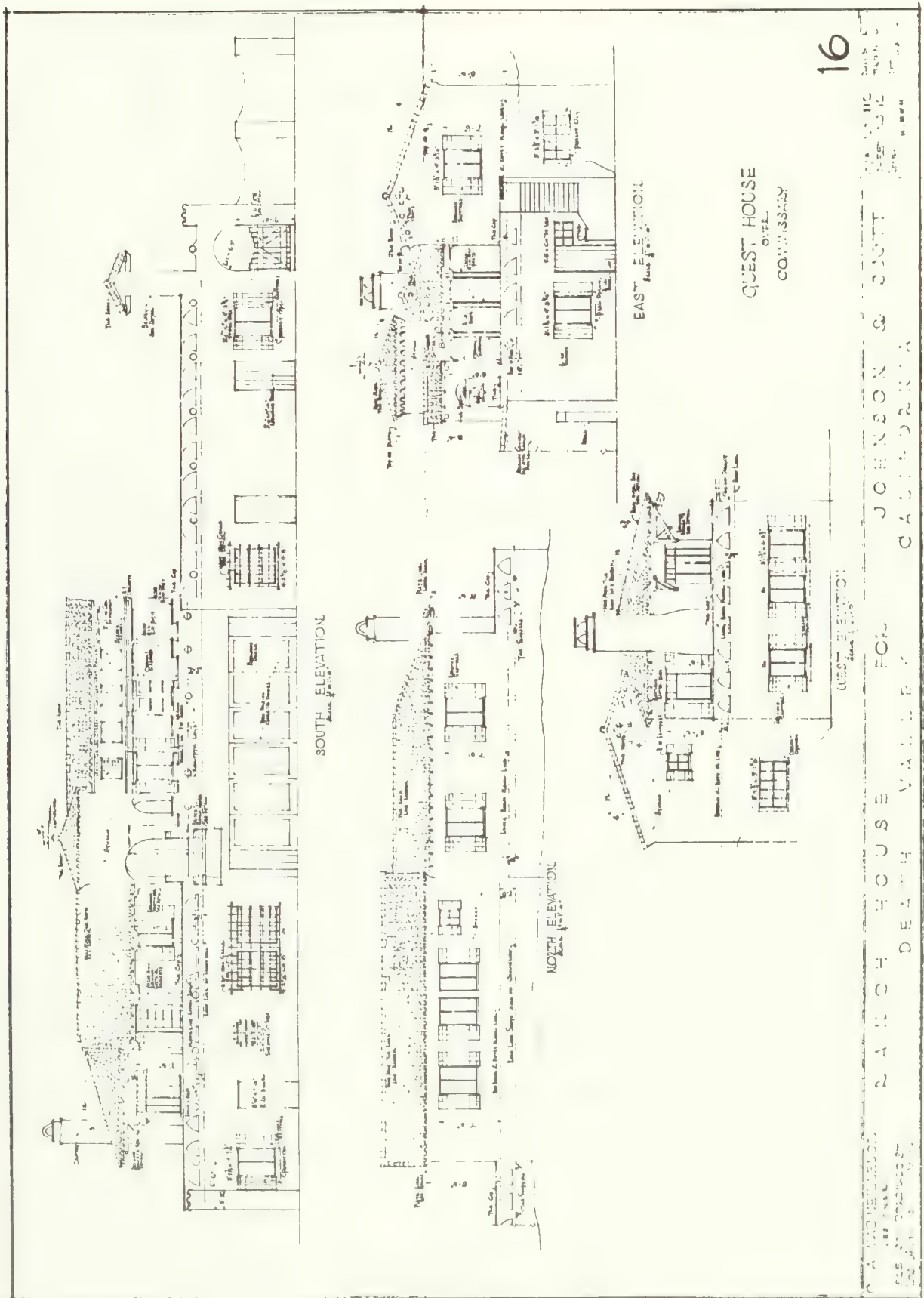
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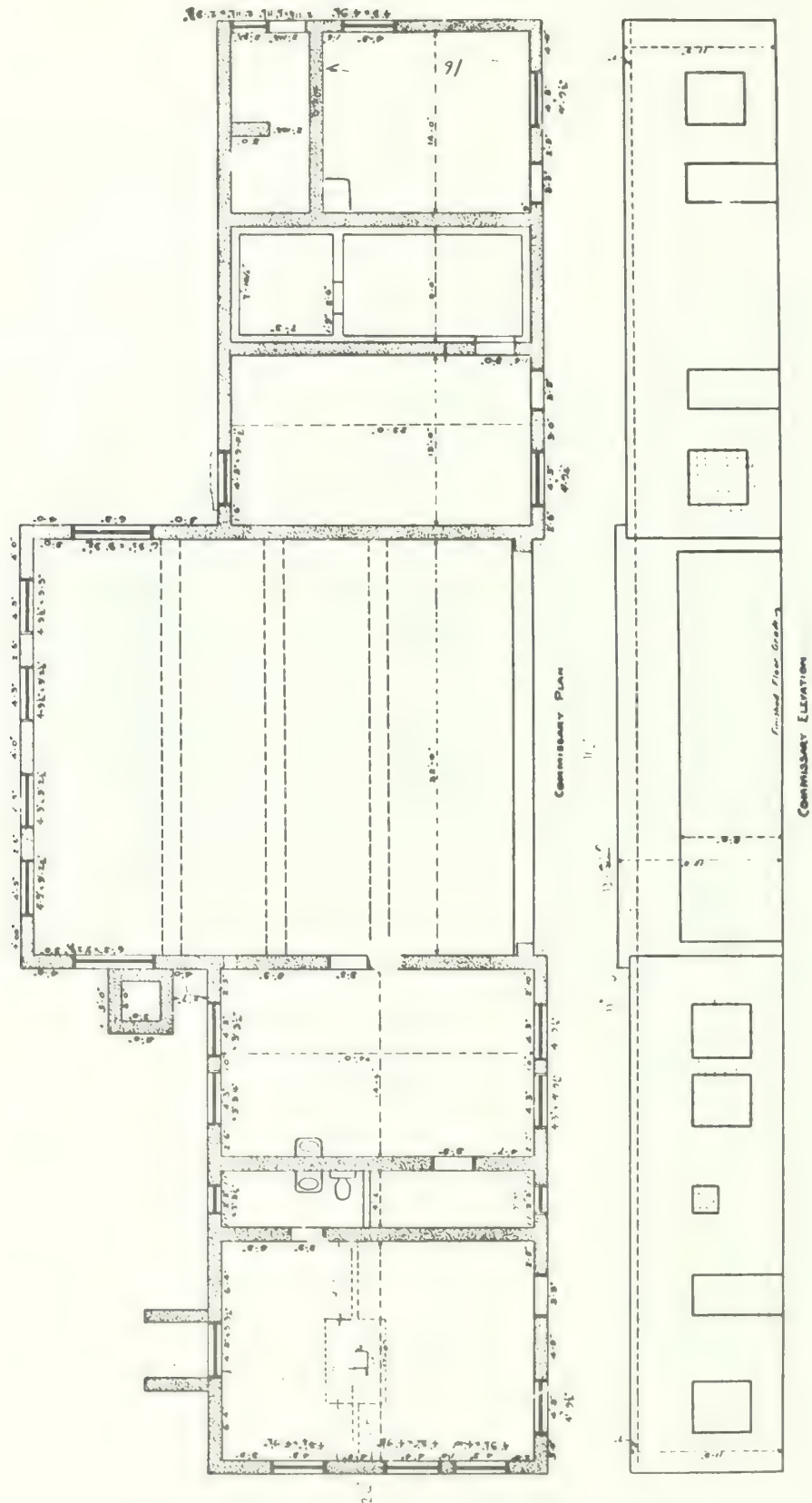
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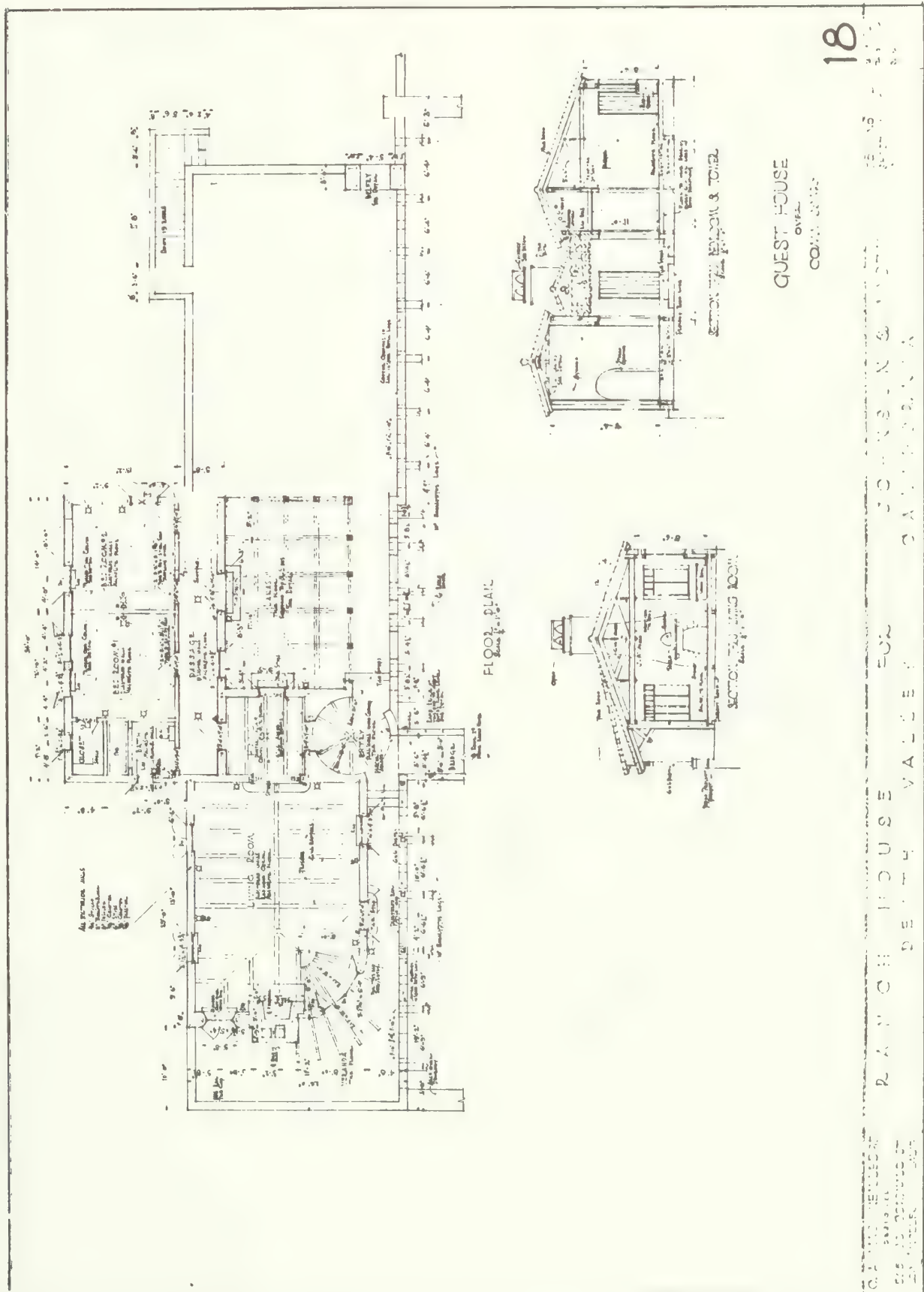
Historic Drawing 15: Upper Music Room Foundation Plan



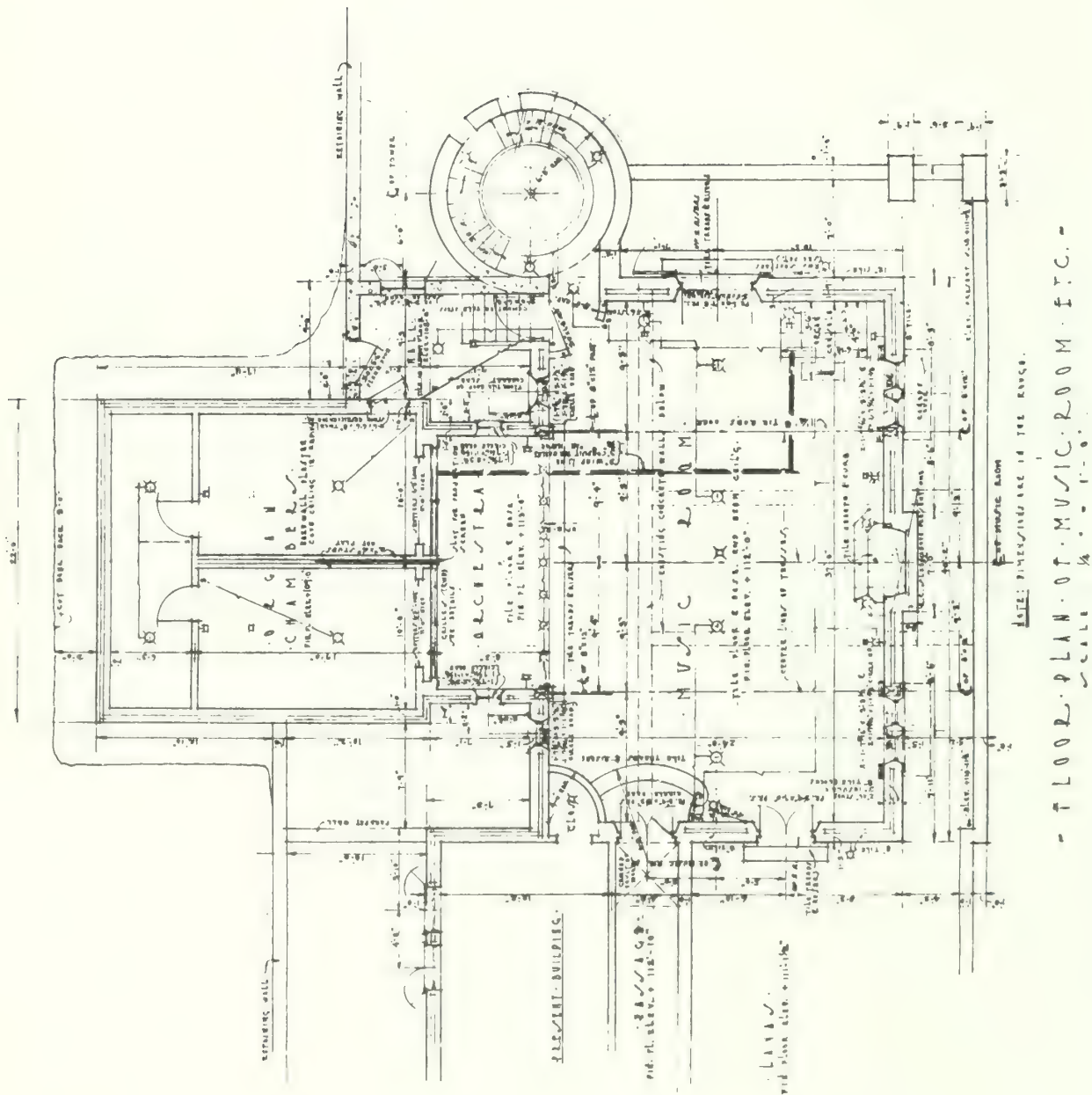
Historic Drawing 16: Annex Elevations



Historic Drawing 17: Annex Plan and Elevation, First Floor



Historic Drawing 18: Annex, Second Floor Plan and Sections

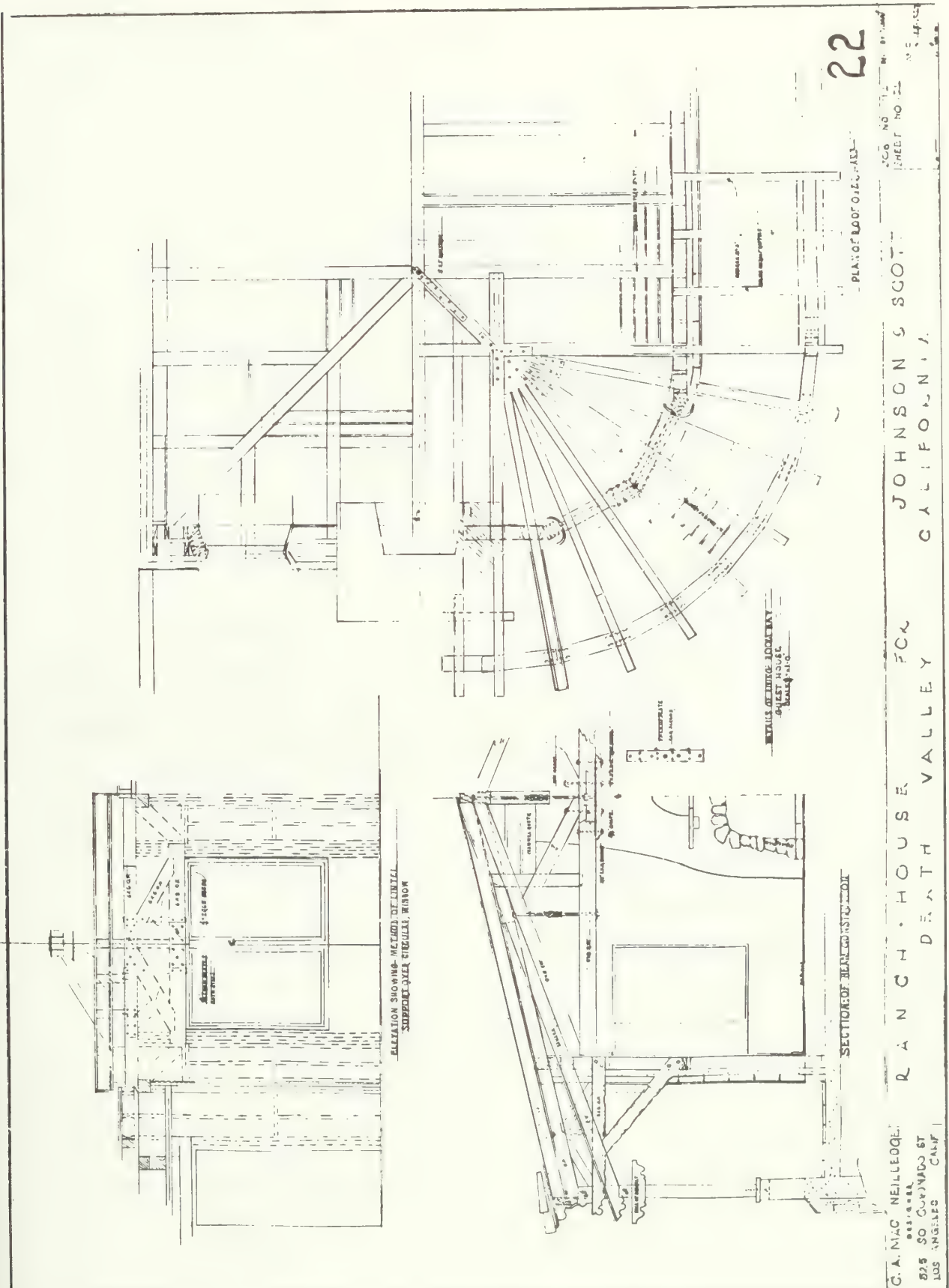


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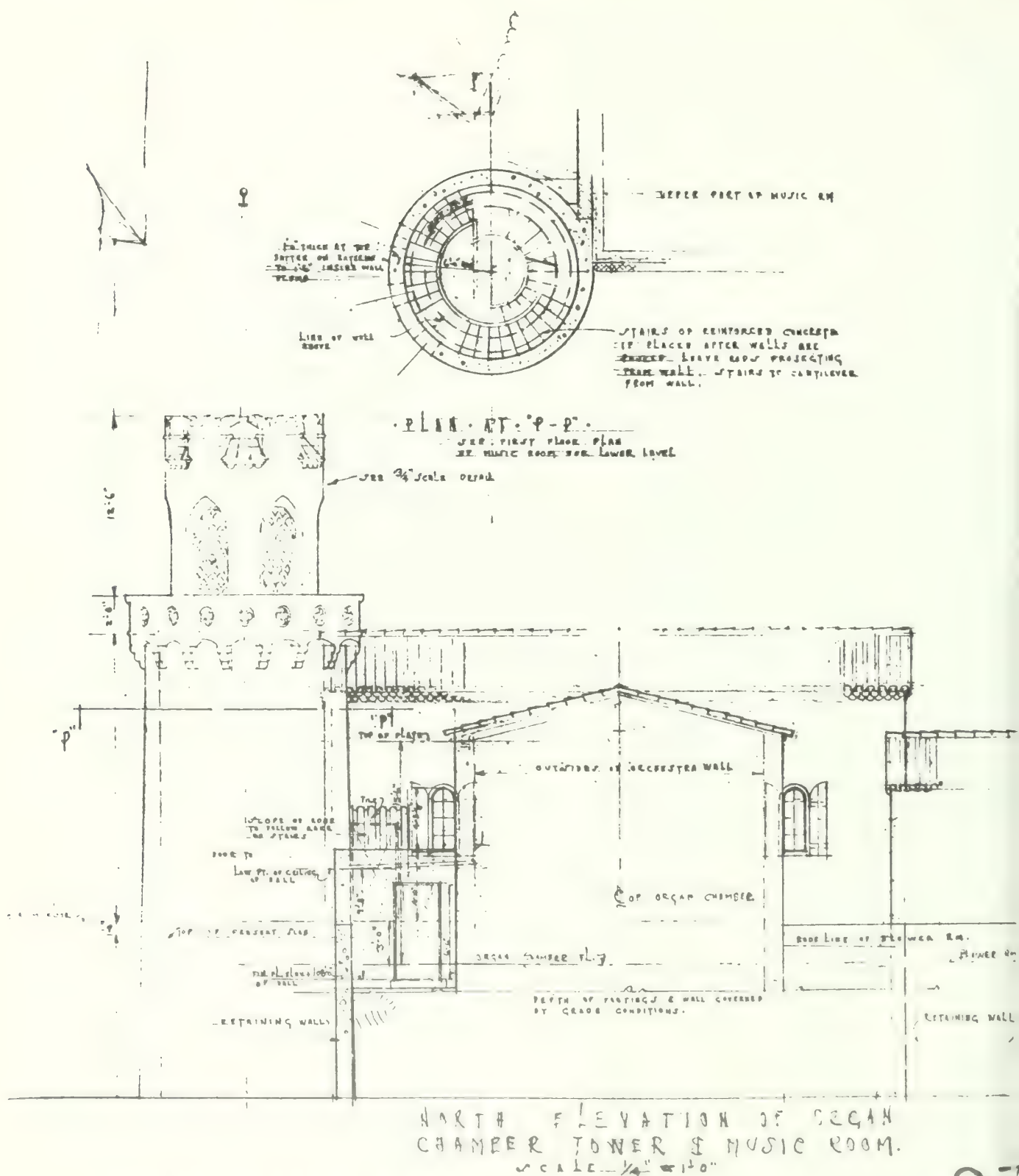
Historic Drawing 19: Upper Music Room Floor Plan



DEATH VALLEY SCOTTY HISTORIC DISTRICT, MAIN HOUSE AND ANNEX HSR



Historic Drawing 22: Details, Corner Bay, Italian Room

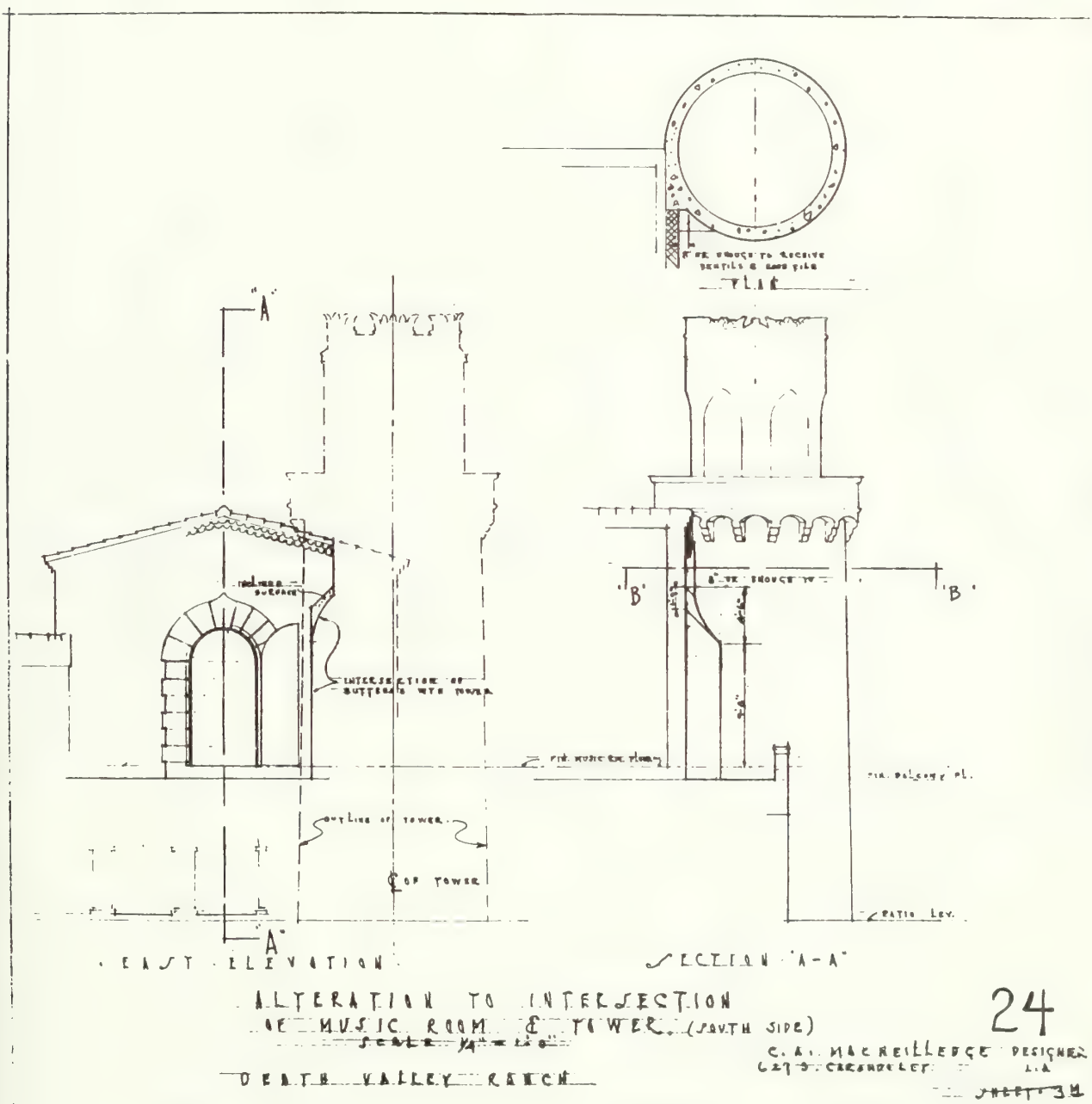


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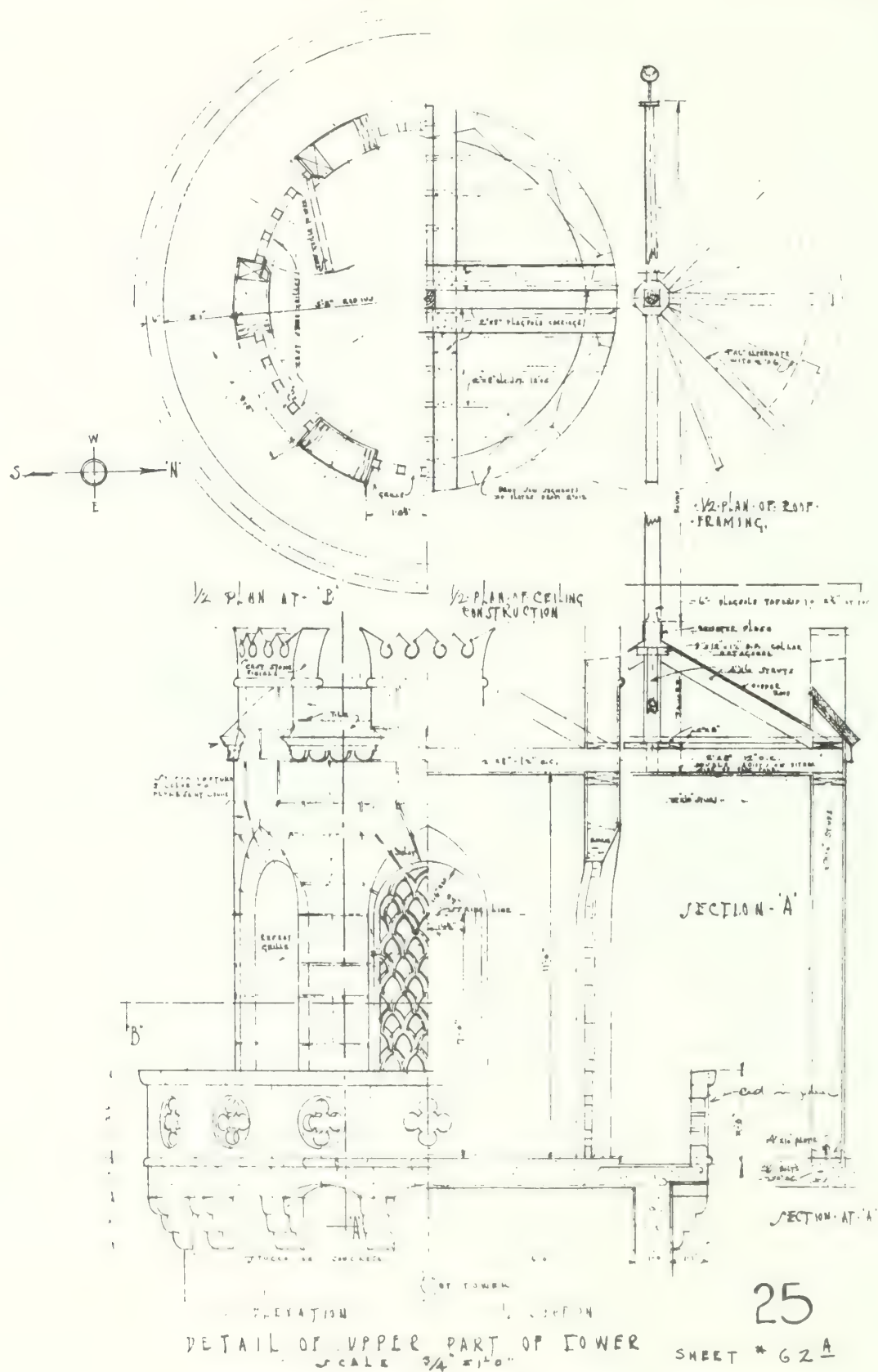
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Historic Drawing 23: Upper Music Room Elevation and Details



Historic Drawing 24: Upper Music Room Tower



DEATH VALLEY RANCH

Historic Drawing 25: Flag Tower Details



Photo 1: Tunnel between Main House and swimming pool. (Photo by D. Snow)⁵⁹



Photo 2: Underside of tunnel roof slab. Shows deteriorated joint filler and concrete as well as a typical uncompleted deck drain. (Photo by R. Silva)

⁵⁹ This group of photographs illustrates conditions which are also discussed in the seismic, concrete and brick chapters.

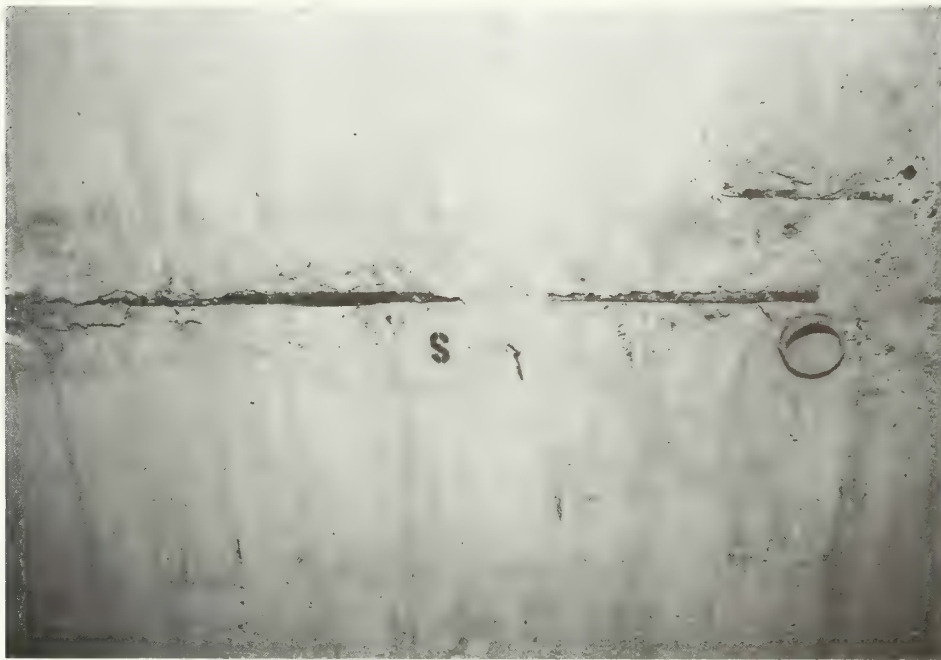


Photo 3: Underside of tunnel roof slab at location "S." Shows concrete spalling caused by rusted reinforcing bar. Another deck drain stub is also visible. (Photo by R. Silva)



Photo 4: Trees against foundation walls. Caused damage in the past, particularly in the tunnel wall near the southeast corner of the Main House. Trees have been removed, such as these in front of the Main House. (Photo by R. Silva.)



Photo 5: Deteriorated brick at foundation of Great Hall fountain. (Photo by R. Silva)



Photo 6: Timber bulkhead. Located at the east end of the tunnel adjacent to the swimming pool (location "U"). (Photo by R. Silva)



Photo 7: End of tunnel at Hacienda (location "A"). (Photo by R. Silva)

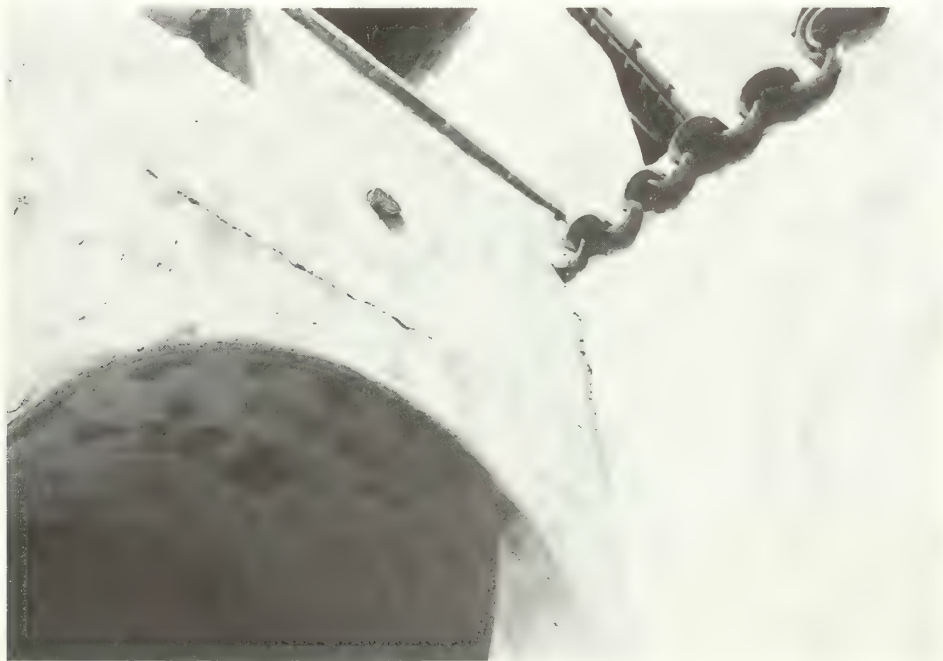


Photo 8: Southeast corner of Annex. Horizontal stucco crack above arch caused by joint in building framing. Vertical stucco crack in corner at junction with east Patio wall is predictable and a candidate for an expansion joint. (Photo by R. Silva)

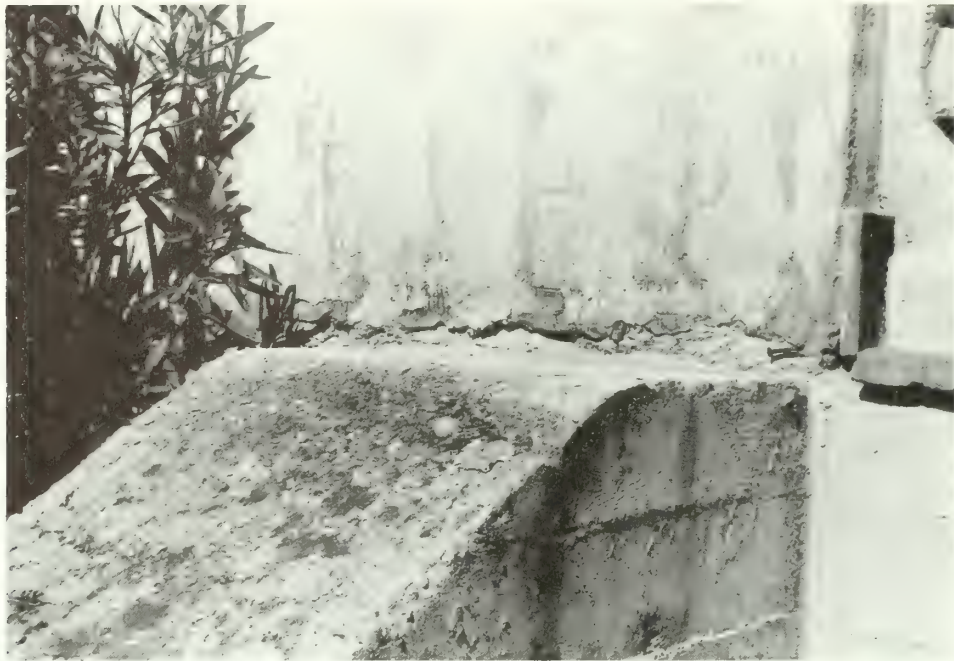


Photo 9: Concrete wall at south porch, Main House. An example of concrete work left exposed when construction stopped in 1931. Most concrete work had been intended to be finished with tile or stucco. Weathering and moisture intrusion are causing gradual deterioration. The crack at the juncture of the stucco and concrete is a typical source of water intrusion. (Photo by D. Snow.)

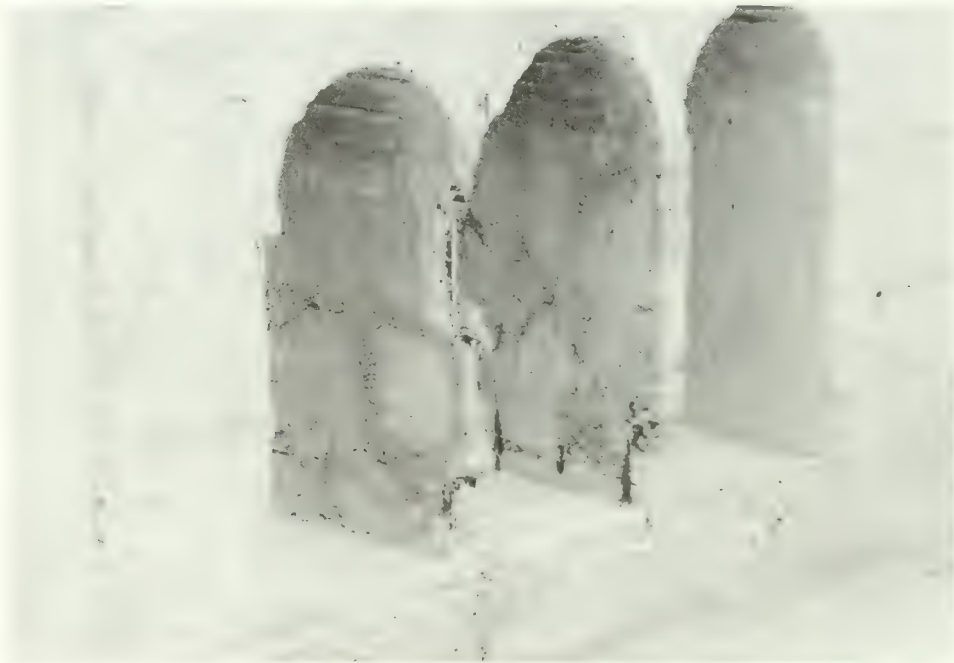


Photo 10: Advanced concrete failure and deterioration. Due to moisture causing rusting and exfoliation of steel reinforcing such as seen in this detail at the swimming pool. The lack of adequate concrete cover over reinforcing can be seen in this detail. (Photo by D. Snow.)



Photo 11: Great Hall trusses. Shows the tension anchors added in the 1970s. (Photo by R. Silva.)

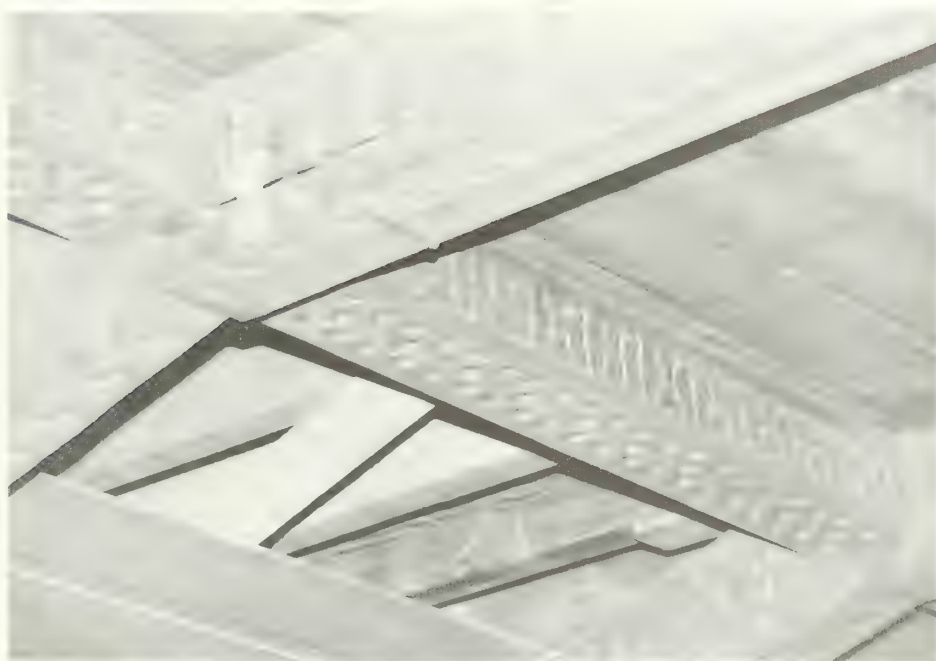


Photo 12: Detail of Dining Room decorative ceiling. Wood failure has occurred because of extreme heat and dryness. With several pieces of ceiling boarding removed, the second floor joists can be seen. (Photo by R. Silva)



Photo 13: West end of second floor Veranda, Main House. Shows temporary supports at cantilevered end of roof. (Photo by R. Silva)

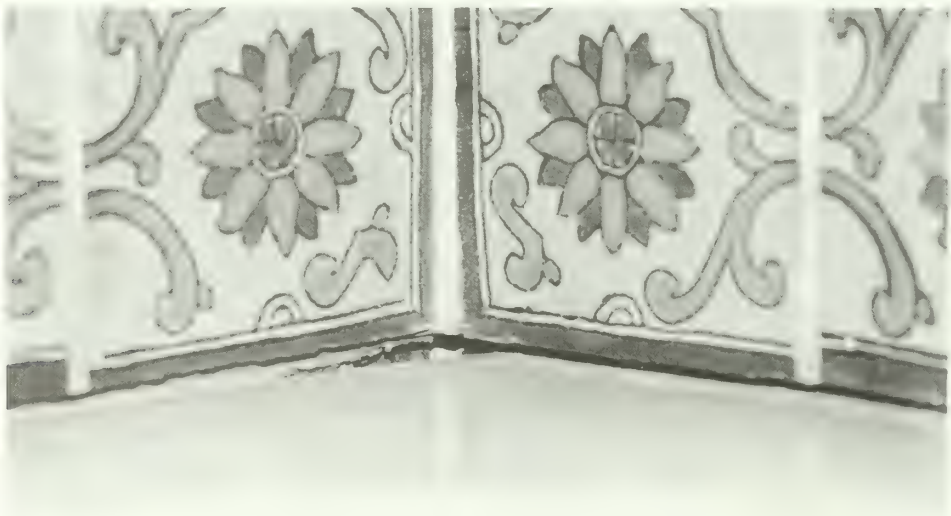


Photo 14: Separation of tile from edge of bathtub, Annex bathroom. (Photo by R. Silva)



Photo 15: Bridge to Annex junction. East side of bridge, showing crack and spalled stucco at junction and stucco cracks along bridge deck level and in railing. (Photo by R. Silva)



Photo 16: Stucco cracks, bridge to Annex junction. West side of bridge. (Photo by R. Silva)

SEISMIC ASSESSMENT

OBJECTIVE

The objective of this chapter is to document an assessment of seismic impacts at Scotty's Castle. The assessment was undertaken by Structural Engineer Richard Silva in 1989 to determine the impacts and possible mitigation for earthquakes, sonic booms, and nuclear test activity.

DOCUMENTATION

Since 1930 the buildings have been subjected to over 1000 ground motion events, both natural and man-made, measuring 4.0 or greater on the Richter Scale within a 109 mile (175 km) radius (see figure 1 and appendix D); an unknown number of sonic booms; and wind loading.

The buildings have suffered extensive stucco cracking ranging in size from hairline cracks to a number of large cracks (see stucco chapter). Some of the more serious cracks occur at the bridge connecting the Main House to the Annex.

Seismic monitoring at Scotty's Castle started in 1979 by URS/John A. Blume & Associates, Engineers, a private firm working for the Department of Energy (DOE) (see appendix B). The seismic monitoring is a result of complaints by the National Park Service for damage caused by high yield nuclear tests conducted at the Nevada Test Site (NTS).

The buildings, although constructed in the late 1920s prior to any seismic building codes for the area and at a time when the state of the art in seismic design was not as advanced as it is today, do contain a lateral-force resisting system. The Main House first and second floor walls and the Annex second floor walls are constructed from 2X4 or 2X6 studs at 16 inches on center with 3/8-inch celotex on one or each side of the framing. The Annex first floor walls are reinforced concrete. The Main House first floor is a reinforced concrete slab, the Annex first floor is a concrete slab-on-grade, and the Main House and Annex second floor and roof are wood framed with board sheathing spanning between the joists or rafters. This information is based primarily on construction drawings, for additional documentation see the Structural Study. Verification of materials and connections between the walls and slabs, etc. was not possible at this time.

ANALYSIS

Most code documents clearly state that their requirements are minimum standards that are meant to provide for life safety but not to insure against damage. An analysis of the buildings, based on the 1988 Uniform Building Code (UBC), shows structural damage to the buildings would be sustained if a major earthquake (magnitude greater than 7) would occur. Calculations, based on estimated building material weights, indicate the building contains less than 50% of the resistance required to resist the 1988 UBC design lateral forces. The assumed unit shear capacity of the existing floors, walls, and roofs are based on the construction drawings and current capacities for similar construction materials. A visual inspection of all wall, floor, and roof connections and materials would be required to ensure life safety.

Wind loading on the structures produces loads that are significantly less than seismic loading and therefore, do not govern in the analysis.

It is difficult at this time to determine which stucco cracks were caused or increased by ground motion. Two 1976 reports (references 5 and 9) state some of the cracking was clearly caused by nuclear test activity. Given the number of tests conducted over the years and the previous high yield tests that were conducted before 1977, some degree of stucco cracking and aggravation of existing cracks can be attributed to event ground motion. Other factors contributing to cracking of the stucco are: shrinkage and expansion, differential movement, wind, local vibration, age, and moisture.

The construction of the bridge along with the movement caused by ground motion has contributed to the stucco cracking at the bridge. The Main House is constructed with wood framing and the Annex contains a concrete bearing and shear wall system on the first floor. The wood framing is a more flexible system than the more rigid and stiffer concrete system. The two systems are joined together by a bridge. The bridge between the Main House and the Annex is rigidly connected to both buildings. The reaction of the Main House to ground motion produces lateral movement greater than the Annex. The different movement of each system, along with the rigid type connections, has probably contributed to the stucco cracking at the bridge.

Monitoring of the bridge during the PEPATO event on 6/11/79 (magnitude 5.4) at the Nevada Test Site indicates that normal foot traffic loading produces a greater vertical response than the event activity (see appendix E).

Peak ground motion data from nuclear testing and earthquakes, recorded at Scotty's Castle since 1979, shows the buildings have not been subjected to unacceptable velocity and acceleration levels. The maximum velocity recorded for an NTS event is 0.267 inch per second (0.679 cm/sec) and 0.311 in/sec (0.791 cm/sec) for an earthquake. These values are within the acceptable limits of 0.2 - 0.5 in/sec proposed by Reference 4 for historic structures and well below the 2.0 in/sec level suggested by the Bureau of Mines. The maximum acceleration recorded is 0.0149g. The level of acceleration generally considered sufficient to produce some damage to weak construction is 0.1g. The lower limit of acceleration perceptible to people has been set by observation and experiment at approximately 0.001g (reference 1).

The building periods for the Main House, the Annex, and the bridge do not vary by much. Natural soil periods for the area are estimated to be greater than the building periods. Therefore, the possibility of the buildings and the soil reaching a state of resonance and amplifying the ground motion that enters the buildings is unlikely.

The following earthquakes measuring from 4.0 to 5.6 were recorded within 22 miles of Scotty's Castle:

<u>Date</u>	<u>Magnitude</u>	<u>Miles from Scotty's Castle</u>
6/13/39	5.0	13.67
6/14/45	5.0	5.59
2/11/49	5.6	14.91
5/25/65	4.0	17.40
2/25/75	4.0	21.13

Damage, if any, to the buildings as a result of the earthquakes during that time is not known.

The maximum NTS event and earthquake recorded registered 6.4 and 6.7 respectively. The following is a list of the 19 ground motion events registering 6.0 or greater taken from appendix D and shown on figure 2:

<u>Date</u>	<u>Magnitude</u>	<u>Miles from Scotty's Castle</u>	<u>NTS Event * Name Unknown</u>
1/30/34	6.3	99.42	
9/14/41	6.0	78.30	
3/15/46	6.3	92.59	
2/9/62	6.25	80.78	*
12/19/68	6.4	58.41	*
9/16/69	6.3	60.90	*
3/26/70	6.3	56.55	*
6/3/75	6.0	58.41	*
6/26/75	6.1	65.25	*
10/23/75	6.2	62.76	*
11/20/75	6.0	64.00	*
1/3/76	6.3	67.11	Muenster
2/12/76	6.3	58.41	*
3/14/76	6.2	60.28	Colby
5/25/80	6.5	84.51	
5/25/80	6.7	82.02	
5/27/80	6.3	78.92	
11/23/84	6.2	71.46	
7/21/86	6.0	63.38	

Most of the high yield nuclear tests occurred in the 1970s. After 1976, the ground motion events with magnitudes greater than 6.0 were produced by earthquakes. The first event causing serious concern at Scotty's Castle was produced by the Muenster event.

TREATMENT

The Department of Energy should continue seismic monitoring at Scotty's Castle. To avoid any delays when the data is needed, the DOE should provide the National Park Service with the data on an annual basis. In addition to the information provided by the DOE in appendix B, the DOE should provide the accelerograms recorded at Scotty's Castle. The accelerogram information should be corrected for instrumented errors and a zero-acceleration baseline established. The information should include the peak ground acceleration, peak ground velocity, peak ground displacement, and duration. Duration of ground motion greatly effects the degree of damage. A long duration ground motion with a moderate peak acceleration may cause more damage than a ground motion with a larger acceleration and a shorter duration.

The magnitude of a ground motion event is usually expressed in terms of the Richter scale. This quantitative measure is useful for worldwide comparisons of ground motion events in both inhabited and uninhabited areas. Along with the Richter scale magnitude an intensity scale should be recorded at Scotty's Castle. Ground motion intensity is commonly expressed in terms of the Modified Mercalli intensity (MMI) scale (see appendix G). The MMI scale is based on the amount, type, and severity of damage caused by ground motion at a particular location. The

MMI scale is subjective, is based on observations of ground motion effects and requires some time to assign an intensity value.

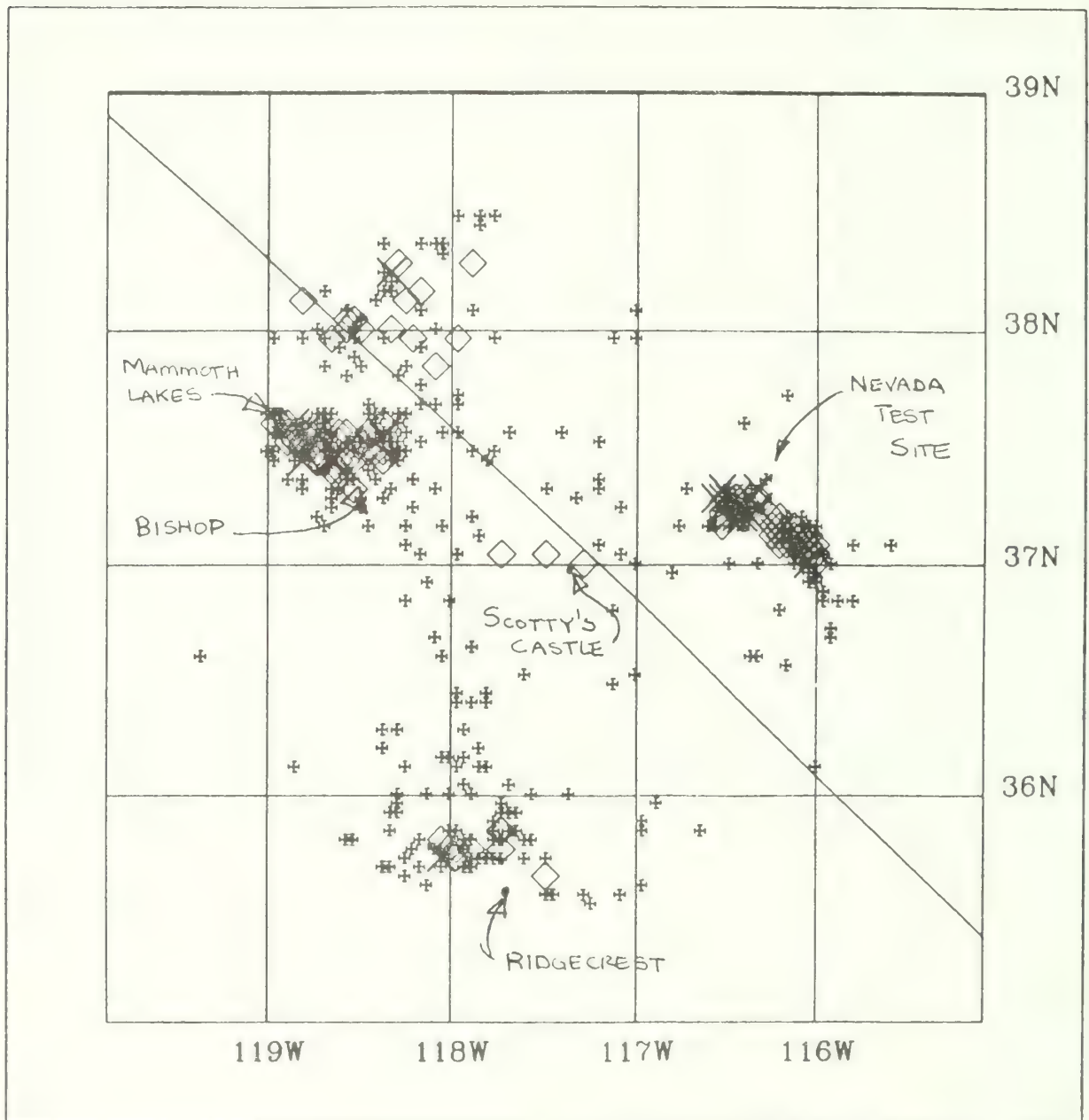
Increasing the lateral resistance of the buildings would be difficult without changing the architectural appearance and character. Reducing the overall weight of the buildings would increase the lateral strength, but again would affect the buildings appearance. Connections and construction materials for the walls should be verified. Destructive investigation and testing of existing materials would be required, so this is not recommended when other work is not required. It is recommended that such evaluation be conducted at those times when it may be necessary to carry out major stucco replacements at various locations. This will allow for inspection of framing and connectors, the condition of materials, insect infestation and assessment of repair requirements as well as seismic strengthening needs.

An expansion joint in the stucco at the bridge to building intersections and an expansion type connection at the bridge to Annex intersection should be provided.

HDF\$ [HDF.PUBLIC]SR111545.DAT

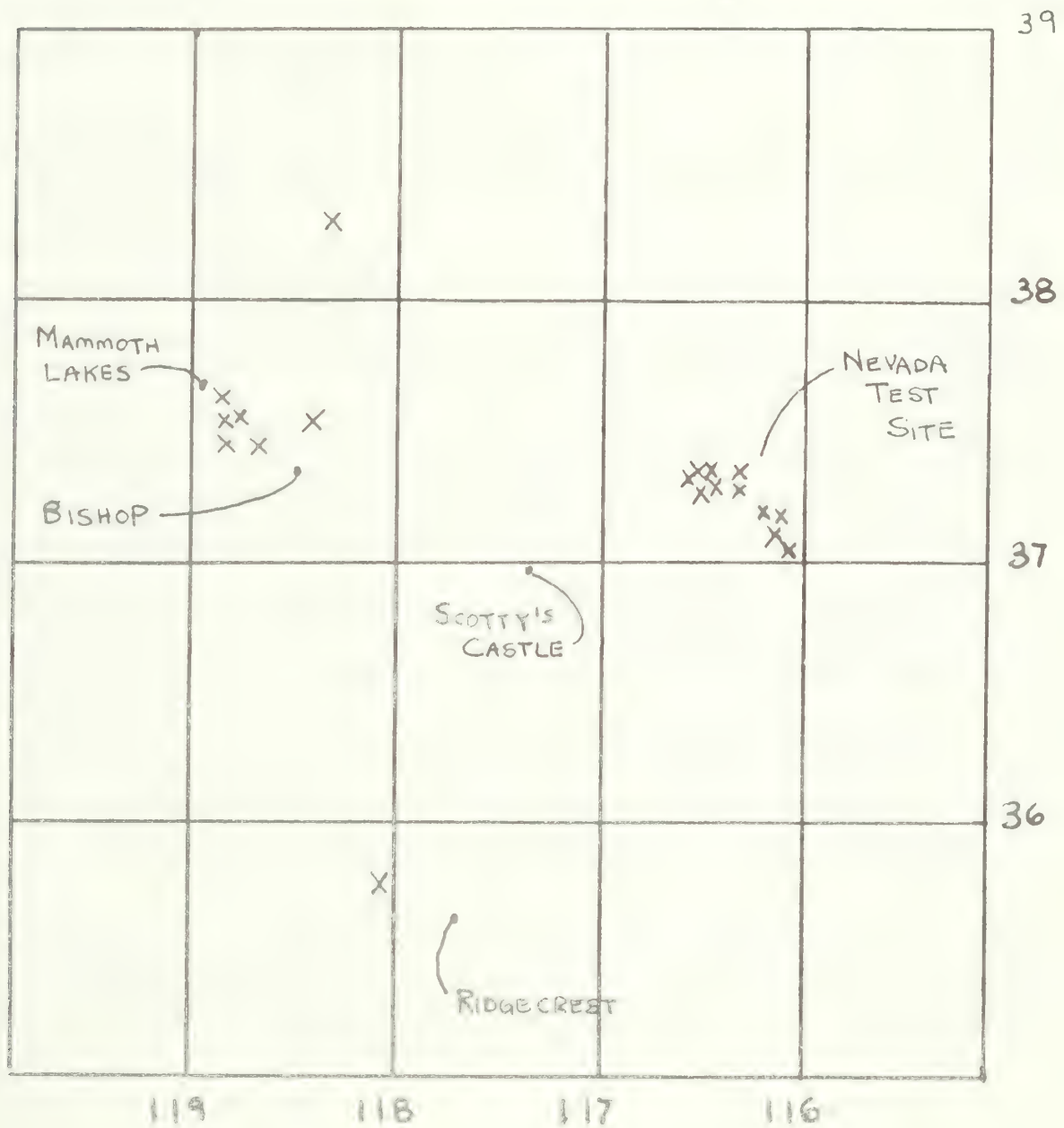
First date: Apr 6 1930

Last date: Jul 25, 1990



U. S. Geological Survey, National Earthquake Information Center
Data taken from the Earthquake Data Base System

Figure 1: Regional Seismic Events



MAGNITUDES: 6.0 - 6.7

Figure 2: Seismic Events in the Vicinity of Scotty's Castle

CONCRETE ASSESSMENT

OBJECTIVE

This chapter of the Historic Structure Report provides documentation, assessment and analysis of historic concrete work of the Main House and Annex of Scotty's Castle.

Some historic information has been obtained from Scotty's Castle records indicating some of the sources and manufacturers of cement and various concrete construction details.

The assessment discussion of this chapter identifies conditions and deficiencies of observable concrete elements of the Main House, Annex and related structural components.

The analysis will identify alternative treatment methods, evaluate the effects of treatment alternatives, and determine the appropriate and recommended treatments.

The specific areas of concern identified in the project Task Directive are:

- A. The need to provide general recommendations for cleaning concrete (of dirt, grime, furnace soot, etc.), concrete preservation, and making minor repairs (spalls, cracks, etc.).
- B. Assess and provide recommendations for several problem areas including:
 - 1. Cracking in the stairs and upper floor of the flag tower.
 - 2. Cracking in the flag tower doors.
 - 3. Spalling and cracking due to rusting and exfoliating reinforcing steel in the tunnel(s), south side of the Main House, south porch of the Main House and the northeast tower of the Annex.
 - 4. Badly cracked, displaced and settled floor of the Annex freezer room.

Assessment of concrete and related problems were conducted during field investigations the week of February 27 to March 3, 1989 and the week of April 17, 1989.

DOCUMENTATION

The following information has been excerpted from historic records in the Scotty's Castle collection, mostly from correspondence during the historic period.

HISTORIC DATA

The following are excerpts from historic correspondence pertaining to concrete. The letters were copied from the historical document collection at Scotty's Castle and compiled in a notebook ca. 1972, as indicated in an attached note by Susan Buchel, dated November 7, 1984. Presumably the file does not include all the letters. The complete group of documents are in manuscript collections (MSS) 5, 6, 7, 9, 10 and 12. The notebook file is listed in the Scotty's Castle library as

No. 979.487N, Acc. #898. Most of the letters in the file are correspondence between Matt Roy Thompson and Albert M. Johnson. The notebook file begins with January 12, 1926 and ends at December 30, 1930.

Thompson to Johnson, April 15, 1927:

The bids on cement are coming in gradually. One received yesterday from the Union Portland Cement Co., Ogden, Utah, from whom we formerly bought Devils Slide cement, quotes us \$3._2 net on Red Devil cement....This is the lowest bid so far received. [Page 1, paragraph 1.]

We poured the slab yesterday for the solarium floor and west porch, which leaves only fifty sacks of cement now on hand. That slab took 58 sacks and required 2-1/2 hours to pour with one mixer, for the 300 cubic feet of concrete. We are covering it this morning with sand and will keep it wet for two weeks. [Page 1, paragraph 2.]

Both new basements are excavated and ceiling slab forms being set today. We will remember to place the eyebolt hangers in each ceiling as instructed. [Page 1, paragraph 3.]

Thompson to Johnson, April 19, 1927:

In accordance with your wishes I have today written the Union Portland Cement Company as per copy of letter enclosed, ordering one maximum car of Red Devil Cement, wording my letter in line with the copy you sent me for that purpose.

The Riverside Company wired yesterday reducing their bid 10 cents per barrel which leaves them still 15 cents above the Utah company, and so it is undoubtedly the best course to order Red Devil cement in the future. I note your suggestion in your letter to Mr. MacNeilledge, that I order cement hereafter as may be needed from the Union Portland Cement Company of Ogden....

One other company, the Utah Sales Company, also made a bid...on BEEHIVE Brand cement, which they guarantee to pass the tests of the American Society for Testing Materials, also the Bureau of Standards....This bid is the same as the Riverside Company's amended bid. The Utah Sales Company's address is Ogden, Utah. It may be well to bear them in mind in case of any future negotiations for cement. [Page 1, paragraph 1-3.]

Thompson to Johnson, May 1, 1927:

Replying to post-script on your letter of April 21: "Have we had Red Devil Cement before?"--As mentioned in my letter of April 18, the Red Devil cement is same as Devils Slide and we used three cars last year with excellent results. The commissary building and the pavement around the garage are built with it. For our work here it is equal if not superior to Riverside as it seems to be more adapted to this dry climate. However, the Riverside cement has also given perfect satisfaction during the cooler spring weather. You will recall that Mr. Walter Clark, contractor at Goldfield, advised us last year that he found the Colorado Ideal cement much more satisfactory than Riverside in many Goldfield buildings he constructed, and the Colorado Portland Cement Company wired you in March 1926 that Devils Slide and Portland Ideal cement are the same grade and quality, both above standard set by American Society tests. We did not find the slightest

fault with the Utah cement, and the fact that it is fifteen cents a barrel cheaper than Riverside, due to larger dealers discount, or rather commission, means as saving of \$300 on the 2000 barrels needed to finish this work.

This week we poured the concrete floor on the roof of the south porch, also the floors of the living room and Scott's room over the SW and NW basements. Both of these jobs are being kept wet and covered. A light sprinkling of sand and a layer of paper was placed over the south wall of the passageway under the living room so that it can be easily removed later if you desire. Eye-bolt hangers were placed in both basements. [Page 1, paragraph 1 & 2.]

The guest house is progressing. Studding is nearly all up. The bridge stringers between it and the main house are in place. The wall between the kitchenette and little bedroom has been poured. Steam pipes and electric conduits are all in place in the guest house and nearly in place in the kitchenette. Insulex is being poured on the roof of the main house. [Page 2, paragraph 3. The Annex was being called the Guest House at that time.]

Thompson to Johnson, May 2, 1927:

The Union Portland Cement Company acknowledgment of our order came today. [Page 1, paragraph 4-6. Discussion of price terms.]

Thompson to Johnson, May 11, 1927:

We have not poured any concrete lately, but will pour the cellar stairway walls soon for both stairways along the north side of the house. All the stucco has been stored in the northwest basement so that the steam pipe tunnel can be extended through the commissary where the stucco was formerly stored....The Utah cement has arrived and is being hauled to camp....There was a thousand sacks in this car. [Page 1, paragraph 3.]

Thompson to Johnson, May 14, 1927:

Yesterday we poured the wall along the north side of the cellar stairs at the NW corner of the house. The main weight of the southwest corner of the guest house rests on the center of the slab above the kitchenette, and we are putting in the 18' I-beam just under the slab to carry this load, this will be above the beamed ceiling of the kitchenette and out of sight, in a diagonal position one end on the east wall and the other on the new partition wall between the kitchenette and bed room, directly under the points of greatest load. This renders the building perfectly safe. [Page 1, paragraph 3.]

Thompson to Johnson, May 20, 1927:

A large supply of new metal lath has arrived. [Page 1, paragraph 5. For stucco ?]

Thompson to Johnson, September 23, 1927:

I ordered the car of steel which will arrive soon. This will contain the wire mesh reinforcing for the upstairs floors in the main house which can then be laid. [Page 1, paragraph 6.]

Thompson to Johnson, October 8, 1927:

We poured the concrete floor yesterday in your up-stairs apartment....We used very heavy wire mesh reinforcing in the floor to prevent any cracks from occurring which would have cracked the tile floors. The reinforcing mesh will of course cause all contraction and expansion movement to occur at the wall lines under the base tile or back of it instead of in the middle of the room. We have enough reinforcing mesh for all concrete floors that are to be laid over wood floors, and the slabs of concrete are to be not less than 1-1/2" to 2" thick for necessary strength. [Page 1, paragraph 6.]

Thompson to Johnson, November 2, 1927:

I ordered four cars of cement yesterday from Union Portland Cement Co., at Ogden, Utah, and asked them about cement in paper sacks for future orders which will be stored several months. [Page 1, paragraph 3.]

Johnson to Thompson, December 19, 1927:

I also placed an order with the Soule Steel Company, or the American Reinforced Steel Company, as follows:

1/4"	square	reinforcing	bars,	7'10"	lengths	10560	lbs.
5/8"	"	"	"	30'	"	23070	"
3/4"	"	"	"	30'	"	<u>1200</u>	"
Total...						34830	"

The Soule Steel Company, or the American System of Reinforcing, 1116 Washington Building, Los Angeles, made me a price of \$2.35 base. [Page 1, paragraph 2.]

Thompson to Johnson, January 29, 1928:

The music room tower is being formed and will be poured next. The spiral stairs will be anchored to the circular walls by iron rods protruding through the treads which will be poured after the walls are stripped of their form lumber. The landings will however be poured monolith with the walls for strength. [Page 1, paragraph 3.]

Thompson to Johnson, February 10, 1929:

Patio tunnel walls are being formed west from the main cross tunnel, and will be poured sometime this week. Have made seven foot head room with full sized door through west wall of cross tunnel and we are leaving water main just outside of tunnel, supporting same on brick piers. This tunnel is just south of the water main and we are using the north wall of the basement stairway for the south wall of the tunnel as for as the west arch making the tunnel 6'4" wide for this section. This saved building an extra wall for that length, and the roof will be 8" thick and reinforced to carry a load of 1500# per square foot. West of the arch the tunnel narrows to 3'6" with headroom of at least 6'6" with 6" slab on top which is to be covered with 10" of gravel so as not to show under the gravel treatment of the driveway. [Page 1, paragraph 5]

Thompson to Johnson, May 1, 1929:

[Page 1, paragraph 2. Cement was ordered from Los Angeles.]

Concrete floor was poured yesterday in the solarium basement and basement under the west porch. This leaves the passage way and main basement to be paved. [Page 2, paragraph 1.]

[Page 2, paragraph 7. Shipped empty cement sacks for credit back to Union Portland Cement Company, Devil's Slide, Utah.]

Thompson to Johnson, May 11, 1929:

[Page 2, paragraph 8. Regarding cement purchased from Riverside Co.]

Concrete floor in the passage way from main basement to solarium basement was poured yesterday. This leaves only the main basement floor to be poured. It will have to wait until tunnel plans are determined as pipes will have to be planned accordingly. [Page 2, paragraph 9.]

Thompson to Johnson, February 2, 1930:

Concrete Work: We poured the roof of the new power room this week, and have waterproofed it with McEverlast an asphaltic preparation which I asked Mr. MacNeilledge to send up after he had recommended it. This coating is also a curative agent as it holds the moisture in the concrete while hardening is going on, and is extensively used on concrete highways by state highway engineers. The back walls of the power house will also be coated with it with a special spray gun, using our electric air compressor to supply air pressure. A man from the McEverlast company is coming up at their expense to demonstrate the uses of this material according to a letter just received from Mr. MacNeilledge.

The floor in the west half of the Guest House basement was also poured yesterday. Forms are set for the cross tunnel to the fuel tanks west of the main house and concrete will be poured in them tomorrow. [Page 1, paragraph 1.]

Thompson to Johnson, February 5, 1930:

Mr. Rivers, the McEverlast Company man, arrived tonight from Los Angeles...to demonstrate the merits of this asphaltic waterproofing and preservative on concrete and pipes....

Walls of the cross tunnel to the fuel tanks were poured yesterday and steel was laid today in the roof slab. Steel is also being placed in the footings for the high wall back of the Annex. [Page 1, paragraphs 2 and 3.]

Thompson to Johnson, February 9, 1930:

McEverlast: Mr. Ivan G. Rivers, the McEverlast man, left this morning for Los Angeles, after giving us a very thorough free demonstration of their products. He sprayed the back walls of the new power house with one coat of McEverlast penetration; and then

gave the north wall a coat of McEverlast second coat. This material appears to be pure asphalt thinned down to a proper consistency for spraying. When it dries it seems to be a perfect waterproofing. He also treated some water pipes with this material and wrapped their fabric around them and then applied two more coats. This makes a very durable protection for water pipes and does not seem expensive or difficult to apply. I think we should use this treatment on all water pipes hereafter. Their waterproofing processes are excellent for walls and can probably be used to advantage on the lake walls. [Page 1, paragraph 5.]

Thompson to Johnson, February 19, 1930:

Air Compressor. The air compressor and tank are now installed in the little room back of the music room tower. It was necessary to have compressed air to apply the McEverlast waterproofing to the power house walls, etc. If the pump is too noisy it can be moved easily to either the filling station or the tunnel under the power house hall, leaving the tank where it is, but possibly installing a small auxiliary tank to provide a cushion in the feed pipe near the compressor. [Page 2, paragraph 4.]

Thompson to Johnson, June 27, 1930:

[Page 1, paragraph 5. Regarding cement from the Monolith and Riverside companies.]

The letters contain additional descriptions of concrete work done but do not include specific technical information.

FINDINGS AND ANALYSIS

General

Concrete construction techniques used at Scotty's Castle appear to have been state-of-the-art and well executed. In contrast to today's methods, the observed differences are the use of dimension lumber for formwork, the use of steel reinforcement consisting of square deformed bars rather than round deformed bars, and a lack of adequate concrete cover of reinforcing. No historic information has been found as yet indicating concrete mix proportions. Cement appears to have been standard commercially available portland. Aggregate apparently came from the site, out of the wash to the west of the complex. Water was from the spring up the canyon. The water quality was described in part in a 1973 engineering report:⁶⁰

As can be determined from the analytical test results...the water supply is generally of high quality and meets or exceeds all mandatory Public Health Service Drinking Water Standards except for the fluoride content. The concentrations of arsenic and cyanide, although within mandatory limits, would normally justify an investigation of alternate sources. However, no alternate source exists in this case, and the concentrations are not high enough to [w]arrant the construction of removal facilities.

60. Beamer/Wilkinson and Associates, "Engineer's Report, Survey and Investigation of Utility Systems, Death Valley Ranch (Scotty's Castle), Death Valley National Monument, California", Beamer/Wilkinson and Associates, Electrical and Mechanical Engineers, 478 Santa Clara Avenue, Oakland, California 94610, (415) 834-4177, 10 November 1973, Chapter I, Water Supply, pp. 1-16, 1-17.

The hardness of the water is very low, even below the solubility of calcium and magnesium in water. The measured alkalinity indicates that this water is mildly corrosive to concrete and mortar pipe linings. The water could be stabilized by the addition of lime, if necessary, but this is not recommended at the present time.

The major cation in the water is sodium. The amount is not excessive or harmful to healthy persons by any standard, but the presence of sodium in the water supply should be considered by persons who have medical prescriptions calling for a low sodium intake.

Fluoride is the only constituent present in the water supply in excessive amounts. Fluoride, in moderate concentrations, is thought to be very beneficial in the control of dental cavities....In higher concentrations, however, it causes a condition known as dental "fluorosis", also called "mottled enamel," in which the teeth turn brown in color....Dental "fluorosis" is primarily a cosmetic problem, since the fluoride still prevents tooth decay. Existing Public Health Service Drinking Water Standard limits have been established to prevent the occurrence of dental "fluorosis" in community domestic water supply systems.

Although the report indicates the alkalinity of the water supply could have had or could have some effect on concrete, there is no further discussion of this, nor whether the sodium or fluoride content may have any effects.

Foundations

There have been no reported nor observed foundation failures or major concrete deterioration in foundations or other major structural components. However, it has been reported by park staff that the section of the north foundation wall of the Main House in the boiler room east of the entrance door becomes damp or wet after heavy rains. This location is at the exterior stairwell and there is no obvious pathway for water transmission through the wall except for some small cracks in the exterior stucco. There is evidence of leakage in this same wall to the west of the boiler room entrance door. This location is opposite the patio planter box.

In the south portion of the Main House boiler room which is beneath the south Entry Porch, there is evidence of moisture penetration at the upper portion of the east end wall, near the intersection with the Main House wall. Any cracks in stucco or tile decking could be sources, as well as damage from root pressure by two palm trees that were adjacent to the building, but have been cut. Lack of positive drainage away from the building walls may also be contributing to water penetration through the foundation walls.

Leakage of the Main Hall fountain is seen on the concrete and brick in the basement below (see the Brick and Fountain chapters of this report). Water penetration has occurred at upper portions of the walls in the Sea Horse room, from the south to west and northwest sides. Two sources have probably been the Salarium fountain, and at the exterior northwest wall, at an open joint between an unfinished concrete wall and the adjacent abutting building wall.

Tunnels

The top or ceiling slab of the main tunnel along the south front of the Main House has several problems that need treatment. It was originally intended that this slab be tiled but this was not accomplished when construction was stopped. The slab has some low areas in which water stands. In part, these are related to drains which were set to the finished tile elevation. Consequently, the drain openings are higher than the concrete surface, so the slab areas will not completely drain. Also the drains are open to the tunnel below, drain piping not having been installed to carry water to the main drains. The standing water or falling water has eroded to some degree the top and floor slabs and slowly penetrates the concrete. Modification of the drains or the top slab is needed to accomplish complete and positive drainage (see the Drainage chapter of this report). Also, the slab should be treated to reduce moisture penetration. This should be done in such a way as to retain the historic unfinished appearance.

The expansion joint material between slab sections has deteriorated. In some places the material is slipping out of the joint. Water leakage into the tunnel is very apparent. These expansion joints need to be replaced and sealed.

There are some cracks in the top slab of the tunnel which allow water penetration. These should be repaired or sealed. Where necessary, the reinforcing should be exposed and treated as part of the process.

When the chain safety guard was installed around the swimming pool¹, holes were bored into the top slab of the main tunnel in front of the Main House for steel posts. In many instances, these holes completely or nearly penetrated the slab, damaging the integrity of the concrete system and allowing water flow into the tunnel. This safety barrier should be replaced with a new barrier to provide proper protection with an appropriate design and the holes in the slab repaired.

There are various locations at the underside of the tunnel top slab (as well as elsewhere in the building complex) where reinforcing steel has exfoliated from continued exposure to moisture and air, also producing spalling of the concrete. All these conditions need repair and will involve various combinations of treatment: steel and concrete replacement, cleaning and protective treatment of the steel with concrete replacement, or cleaning and protective treatment of the steel with concrete patching.

The tunnel wall off the southeast corner of the Main House needs repair where damaged by the pressure from tree roots.

Historically Unfinished Concrete and Exposed Steel

There are various conditions in the building complex where concrete work was left unfinished when construction stopped in 1931. Many of these surfaces or features were intended to be tiled. From the preservation standpoint now however, these surfaces need to be left and preserved as uncompleted construction. Unfinished concrete has eroded, cracked or spalled, exposing reinforcing which exhibits various degrees of deterioration, from minor surface rust to severe exfoliation.

Examples are at the south entrance steps of the Main House, the stoop at the second floor rear access to the Annex (near the northwest corner of the Music Room), as well as various

unfinished concrete elements west of the Main House and Annex and of the swimming pool. There are also many cut ends of form ties that need treatment to prevent exfoliation and ultimate damage to the concrete.

When construction stopped, there were many locations where reinforcing bars were left projecting from concrete walls, such as at the swimming pool, the patio area west of the Main House, and the wall behind the Annex. These protruding bars were cut or burned off by the Gospel Foundation because they were a safety hazard.⁶¹

Flag Tower (Music Room Tower)

Of concern here is cracking of the concrete of the spiral stair steps and upper landing inside the tower and in the concrete grill doors at the top of the tower. As deduced from the historic correspondence, the stair treads are anchored into the concrete wall of the tower. The landing was described as being monolithically cast with the tower walls. In both cases the concrete cracking could expose the steel to moisture causing rust and exfoliation. This is also true of the concrete doors. The cracking is probably due to temperature and loading stresses. Although there is no evidence of a structural threat in the stair and landing, non-destructive (x-ray) testing would provide assurance or the degree of protective treatment necessary.

Annex Freezer Room Floor

The failures of the floor in the Annex Freezer Room are probably caused by compression or deterioration of the cork insulation layer beneath the finish concrete slab.

Cleaning Concrete

Much of the concrete in the Main House boiler room needs cleaning to remove the soot build-up from boiler fuel oil. In other locations, oil or grease should be cleaned up.

TREATMENT ALTERNATIVES AND RECOMMENDATIONS

For additional discussion and recommendations, see the Drainage and Structural chapters of this report.

1. Water for concrete work. Although it does not appear that the site water contains chemicals of sufficient quantity to cause concrete deterioration, an evaluation by a concrete chemist is advised.
2. Foundation wall moisture leakage/dampness. Monitor the Main House basement foundation walls and record occurrences of dampness and leakage to determine the causes and sources and the conditions of occurrence, such as after rains or watering of the planter boxes. For additional discussion, see the Drainage chapter of this report.

61. From notes by Susan Buchel on a visit to Scotty's Castle by Mary Liddecoat, February 12, 1983.

3. Tunnels.

a. Modify drains, main tunnel top slab. Reduce elevation of top of drain sleeves; install drain piping to main storm drain. (See Drainage chapter of this report.) (Drain piping was installed in 1989 from the basement Pelton wheel, from the Powerhouse Pelton wheel, from a watercourse pond drain, and from the watercourse outlet. This has greatly reduced the volume of water which formerly had run in open trenches in the tunnels.)

b. Concrete moisture protection, exposed top slabs of tunnels. A clear sealer is recommended to reduce moisture penetration, which is especially detrimental to the reinforcing. Although the sealer will darken the color of the concrete somewhat, this will maintain the historic unfinished appearance.

c. Replace and seal expansion joints. Most deteriorated expansion joints are in the top slab of the main tunnel, but do occur in other locations. The deteriorated joint material should be completely replaced. It will probably not be possible to achieve as much compression of the joint filler as in original construction so a sealer will be needed as part of the joint assembly system.

d. Where reinforcing steel is exposed, remove rust and exfoliation, replace exfoliated steel as required, provide steel protective coating, and replace concrete as required; patch spalled concrete; repair or seal slab cracks; various locations, including main tunnel top slab and slabs and walls in the tunnel complex.

e. Repair tunnel wall off southeast corner of Main House.

4. Replace the safety barrier along the swimming pool and repair the holes previously bored in the tunnel top slab.

A new safety railing could be anchored to and supported by the threaded pipe which was intended to be the pool gutter drains. This would also protect the pipe stubs as well as keep water out of them.

5. Provide protective treatment of both concrete and exposed steel reinforcing and form ties at all areas of exposed concrete work. Provide treatments which will maintain the historic appearance of the concrete and the incomplete project.

6. Provide non-destructive (x-ray) evaluation of the condition of structural and reinforcing steel in various concrete elements, including the stairs, landing(s) and doors of the Music Room Tower, and possibly various slabs, such as the top slabs of the tunnel complex. Such evaluation is needed to determine any specific treatments.

7. Concrete Cleaning. Removal of soot, oils, grease and other stains can be accomplished with various cleaning agents and poultices. Some methods commonly used or used in the past should not be used, especially on historic concrete, because they are too harsh or utilize toxic materials.⁶²

62. Concrete repair and cleaning methods can be found in the Concrete Manual, Eighth Edition, Revised Reprint, U. S. Department of the Interior, Water and Power Resources Service, 1981. Selected information will be useful, but certain materials and methodologies are out of date and should not be utilized.

BRICK PRESERVATION

OBJECTIVE

A procedure or procedures need to be determined for cleaning and preservation of brickwork in portions of the foundations of the Main House. Of particular concern is some deteriorated brickwork in the Great Hall fountain foundation.

DOCUMENTATION

No significant documentary information has been noted as yet. Historic drawings of the Main House indicate the basic foundation configuration but do not show the extent of the brickwork. The historic foundation plan drawings have a notation indicating that the brick was installed during the major construction period of the Main House (1926-1931).⁶³ Additions and modifications were made to the original 1922 foundations under the building. Concrete was poured as high as possible, then the remaining space was filled with brick. This is seen under the Great Hall fountain and some of the foundation walls under the east portion of the house.

ANALYSIS AND FINDINGS

The brickwork of the Great Hall fountain foundation has been affected by fountain water leakage. Some leaching of minerals has occurred, leaving efflorescence on the surface. At an area at the top and another at the bottom of the south face of the fountain foundation section, the brick is soft and crumbly, at least in the outer wythe. The brick is a coarse red clay, probably backing brick rather than a finish brick. The cement mortar is hard but not dense, a consequence of the mix containing significant proportions of larger aggregate.

The majority of the brickwork surfaces appear to be sound, but the condition of the brick and mortar within the interior of the mass needs to be determined.

Efflorescence on soft crumbly brick cannot be removed without severe erosion and damage to the brick, but could be removed from sound brick.

ALTERNATIVE TREATMENTS

Test results should indicate the range of alternatives, which can be predicted to be: (a) no treatment required except replacement of some deteriorated surface brick, (b) stabilization or strengthening with a consolidant or pressure grouting, or (c) complete replacement. The latter alternative is not predicted to be necessary.

⁶³ See Drawing No. 143/41029, sheet 4 of 41, date missing (this was sheet 4 of the original set of 41 sheets); or Drawing No. 143/41029A, sheet 1 of 9, or 143/41029C, sheet 1 of 8, Dec. 3, 1926. Also see Drawing No. 143/41029A, Sheet 2 of 9 (sheet 1 of the original set dated Aug. 13, ? 1925 ?), (or 143/41028A, sheet 25 of 26, June 25, 1926), (or 143/41028B, sheet 1 of 12, June 25, 1926), showing some original wall removal and details of the fountain footing.

RECOMMENDATIONS

Determine whether the existing brickwork should be stabilized or strengthened with the use of an injected consolidant or grout.

An initial inspection would be to remove a small area of deteriorated surface brick to observe the conditions in the second wythe (and replace with used or new brick).

Then core borings and compression test samples could be utilized to determine stability, strength and the need for stabilization or consolidation. This could be accomplished by contracting a firm specializing in masonry consolidation to analyze the materials, determine the need, feasibility and limitations of consolidation, procedures, chemical design and cost of treatment. A two-phase contract could be considered so that actual treatment would be contingent on the findings and review and approval of the first phase.

Following determination of appropriate treatment and after treatment, or should it be determined that no consolidation is required, the deteriorated areas of face brick should be replaced.

If it should be determined that consolidation or other treatments are not appropriate or feasible, and that replacement of the foundation masonry would be required, the work should be coordinated with fountain repair/restoration.

Although the surface deposits of minerals (efflorescence) are minor, the brick could be cleaned using a soft bristle brush with a mild detergent in warm water. The use of muriatic acid is not recommended.

STUCCO AND PLASTER ASSESSMENT

OBJECTIVE

There have been a number of questions about exterior stucco and interior plaster on the Main House and Annex. One of the primary goals of this chapter will be to provide possible answers to these questions, and follow up with analysis and recommended treatments. An evaluation of the effects of recommended treatments is included in the compliance section of the report.

It is important to note that stuccos and plasters are highly visible historic finishes, making them, collectively, a highly significant character defining element.

DOCUMENTATION

One of the most important tasks in terms of documentation, was the recording of stucco textures. Historically the stucco received a great deal of attention during the design phase. All areas of the buildings were carefully planned to have a certain aesthetic effect, and the wall and ceiling textures were an important factor in distinguishing one finish from another. These different textures are presented in graphic form and labeled with their historic name where known. Other documentation includes photographs, historic specifications and correspondence. A list of figures in this chapter is as follows:

1. Typical Stucco Textures
2. Typical Stucco Failures
3. Detail at Refrigerator Room, Typical Wall Section
4. Typical Exterior Stucco Section
5. Typical Wall Section, Portals and Arches
6. Typical Wall Section, Main House
7. Typical Wall Section, Exterior West, South, East Walls, Annex
8. Typical Wall Section, North Wall, Annex
9. East Elevation, Main House, Annex
10. South Elevation, Main House
11. Roof Plan, Annex
12. First Floor, Annex
13. Second Floor, Main House
14. First Floor, Main House
15. North Elevation, Annex
16. Second Floor, Annex
17. North Elevation, Main House
18. Section East of Bridge, Main House, Annex
19. Section at Garage, Annex
20. Reflected Ceiling Plan, Annex
21. West Elevation, Annex, Main House
22. South Elevation, Annex
23. Recommended Treatment C-4
24. Recommended Treatment E
25. Recommended Treatment C-2
26. Recommended Treatment C-1

ANALYSIS / FINDINGS

List of Types of Stucco and Plaster Failure

1. Hairline cracks where stucco or plaster has not lost its key.
2. Larger cracks where stucco / plaster has not lost its key.
3. Hairline cracks and bulging of the finish surfaces, where the stucco or plaster has obviously lost its key. (delamination from substrate)
4. Substrate is delaminating from the superstructure of the building.
5. Stucco/plaster has spalled off in pieces or had to be removed because it was a safety hazard.
6. Stucco/plaster is cracked all the way through the substrate, with cracks reflected in the interior plaster at the same location.
7. Stucco/plaster is cracked diagonally at corners of window and door openings.
8. Stucco/plaster has been chipped off or removed by human wear or previous lawn watering.

Existing Conditions

The overall condition of the interior plaster is very good, however some exceptions are hairline cracks (primarily at wall openings) and water damage in the Annex Refrigeration and Freezer rooms.

The exterior stucco appears to have more general hairline cracking and in some areas (the bridge) there is concentrated cracking. The most severe damage is in several sections of the first floor of the Annex, where stucco and plaster is delaminating and cracking due primarily to excessive moisture penetration. Considering the number of years (nearly 60) the exterior stucco has been exposed to the elements, it is in generally fair to good condition, discounting the water damaged areas. The structures have been subjected to seismic events, either in the form of earthquakes or nuclear tests (see also the structural and seismic assessment chapters), flash flooding, leaking fountains, and moderately heavy visitation. These effects are identified on the drawings and photographs in this report.

Characteristics of the Materials

Exterior Stucco. There have been fairly extensive lab testing on the exterior stucco (see appendix K). It was applied in a very distinctive manner in an attempt to replicate weathered adobe. There are few signs of it ever having been repaired. The material has remained in a well preserved state, probably due to the hot and dry climate, maintaining its intended appearance over time.

To achieve the desired appearance of weathered adobe, it was applied with a thick, two layer, scratch coat (3/4"-1") of portland cement and then covered with a thinner (1/4") brown coat. This brown coat was then raked while it was still damp with a metal lath screen, or scarifier, leaving vertical marks at approximately 3/8" on center. A final spot coat appears to have been literally

thrown at the wall and then troweled smooth, deliberately leaving about 25% of the raked brown coat exposed. This lighter colored coat was very thin (1/16"-1/8"). See appendix K for material composition and technical data.

Interior Plasters. Interior plasters were applied with the same purposeful and artistic techniques as the exterior stucco. The difference here are the numerous textures and colors that varied from one room to another, depending on the function, or who the room was being rendered for (see photos and graphic depictions). The plaster used in the upper music room of the Annex, for example, was described as "acoustical plaster"⁶⁴ and was designed to be soft for sound absorption. It has an extremely porous appearance and is so soft that furnishings rubbing up against it have gouged grooves in its surface. Each specific texture is described with drawings and photographs.

Deficiencies and Causes of Failure / Condition Assessment

The following is a list of specific types of failure and their suspected causes:

Hairline Cracking. The majority of the exterior stucco has been affected by hairline cracks occurring at fairly regular intervals. Most of these cracks can be defined as cracks that are not readily noticed by the casual observer from ten to twenty feet away. There are actually less hairline cracks evident than might be expected in a structure of this age. The building is in an environment (Death Valley) of extreme temperature ranges, and known seismic activity. For environmental data see the Climate Control Assessment; for seismic activity and for structural analysis, see the Structural and Seismic Assessment chapters. Hairline cracks are usually the result of extreme temperature fluctuations causing differential expansion and contraction of dissimilar materials used as substrates. Other factors that can cause this type of cracking are seismic structural loading (lateral loading), absence of expansion joints, high wind loads and allowing the material to dry too quickly during the initial application. All of these factors have likely contributed to the existing hairline cracking.

Over time, hairline cracks allow moisture to repeatedly seep behind the surface and enter the wall, thus creating more serious cracks. But until this condition exists, there is little to be gained by treating them. Their very existence helps to relax the finish layer of stucco, acting in theory, as expansion joints. Additionally, it is very likely that attempts to patch hairline cracks prematurely could result in a more adverse appearance, thus making them even more visible. Again, the overall historic appearance of the stucco surface should be kept in mind, as it is a primary character defining feature.

Rust and Water Staining. There is a small amount of staining and discoloration on the exterior stucco. Considering the number of years it has been subjected to the harsh Death Valley climate, this problem is not serious. In most cases, the rust staining has resulted from deteriorating hardware (light fixtures, railings, fittings etc.) This staining is having little or no deleterious effect on the stucco except where the deterioration of the metal has advanced to the point where it has begun to exfoliate. Generally the staining by the deteriorating hardware may actually add

64. Memorandum from M.R. Thompson, May 1, 1927 Manuscript Collection, Scotty's Castle Library; 979.487, Acc. #898. "Plasterers are inside the Music Room finishing the acoustic plaster, after which they will tackle the travertine special work."

a certain positive antique appearance to the structures, as long as it does not become so excessive as to have an adverse effect on the overall historic appearance of the stucco.

Structural Cracks. There are cracks in some areas that have no doubt resulted in, or been exacerbated by, lateral or settlement forces (see structural chapter). These types of stucco failures can be categorized as cracks which are visible with the naked eye from more than twenty feet away, and occasionally penetrate the wall or ceiling to interior plaster. A more detailed discussion of the actual cause of these cracks, and the treatment of the causes, is addressed in the structural and seismic assessment chapters of this report.

Once the cause of stucco failure has been determined, a decision will have to be made as to the type and extent of repairs warranted. As stated previously, unless the crack allows serious moisture penetration, it is probably best left alone.

Separation of Stucco from Substrate (Delamination)

There are several areas in the Annex where the stucco has delaminated (lost its key or bond) from the substrate. The Annex is the only building portion where this has been observed. In all cases, this delamination primarily appears to be the result of moisture saturation of first floor ceilings and walls. There are several probable causes for this:

1. The first floor of the Annex on the east, west, and south sides is covered by a second level, open tiled deck, which includes the Lanai deck. The remaining portion of the second floor, and its access from the bridge, is raised above the concrete superstructure of the first floor (figure 19). Several scuppers through the parapet wall were designed to convey runoff from the deck. However, there is ample evidence that water has soaked through the parapet, as well as the deck itself. Cracks in the parapet, permitting this seepage, probably began as hairline cracks that were gradually enlarged by moisture penetration, along with other structural forces (earthquakes, differential expansion and contraction of materials, etc.). In several areas this has allowed the saturation of the first floor stucco ceilings and walls. In some instances, it appears that the tile deck is no longer (or never was) adequately sloped, and rainwater flows toward the second floor walls.

2. There is one scupper in the northwest corner of the Lanai. It appears to drain northward under the raised portion of the second floor (Will Roger's Room) through a pipe or an open masonry trough and exit through a scupper in the north Annex wall. This has likely been the source of water to saturate the Annex north wall. It is very likely that water from this drain flooded the extensive areas under the second floor rooms and seeped through to the alcove ceiling.

3. There is a fountain located in the center of the Lanai deck. When it was in operation, it was probably a concentrated source of water which saturated the surrounding floor, walls and first floor windows. This fountain could account for the seemingly high degree of moisture damage in this arid climate.

The stucco has delaminated on the north wall from what appears to be water drainage from the Lanai deck. It is separating from its substrate (the cast-in-place concrete wall). This is happening where the stucco was applied over a bituminous coating that was previously applied to the concrete, thus creating a natural separation point, or weak bond, between the two incompatible materials (see typical wall section, figure 2, sketch 2).

The deteriorated wall condition and delamination on the south elevation appears to also be caused by moisture entering the wall from above in the same manner as the north wall. The difference here, however, is that the stucco is delaminating along with its substrate. The construction of the wall differs in this location, as a veneer of hollow clay tiles and insulex were introduced there, apparently for the purpose of keeping the wall cool.⁶⁵ The weakest part of this wall would then seem to exist where the insulex was installed between the clay tile and the poured in place concrete. This is the point where the wall is delaminating (see typical wall section, figure 2, sketch 1).

4. The ceiling of the Garage (alcove) and Refrigeration Room (archive storage) is missing about 50% of its plaster. The detail here is similar to that of the north wall, where it was applied over concrete that was initially coated with a bituminous material. After portions of the ceiling plaster began to fall, other loose areas of this plaster were removed by hand because it had become a potential safety hazard.

5. The plastered ceilings and walls in the Refrigerator and Freezer rooms have considerable damage from several different causes. Here the plaster substrate consists of cork. There is a high probability that water saturated the ceilings and walls from the second floor deck, as it did elsewhere in the Annex. The obvious incompatibility of materials, i.e. differential expansion, contraction, shrinkage, all could have contributed to the failure. Again, the plaster delaminated at its weakest point, the connection between it and the cork substrate.

Mechanical Damage

Exterior Stucco. There is some mechanical damage to exterior stucco, usually at or near the grade level, as a result of people leaning on or kicking the wall as they walk by, and due to rain water splash or from sprinkler systems. This type of damage is especially visible at the "travertine" rendering at the base of walls. An example is at the columns of the porch on the east side of the Main House.

Interior Plaster. For the most part the interior plaster is in excellent condition. The significant exception is the Upper Music room and Freezer room in the Annex. The plaster in the Upper Music Room was designed to be soft for its acoustical qualities,⁶⁶ but is also extremely vulnerable to damage when anything rubs up against it. There is damage from chair backs visible on the south interior wall. There is also damage at one window sill where the steel lath is exposed. This could be from moisture, but also could be from opening the window.

65. Memorandum from M.R. Thompson, July 8, 1928, Manuscript collection, Scotty's Castle Library; 979.487, Acc. #898. "We believe that cement mortar would not have held brick in place more firmly than the insulex held the tile to the cement wall. This shows what tremendous strengthening effect the insulex will have in all the walls of the building.

66. Memorandum from M.R. Thompson, May 1, 1927 Manuscript Collection, Scotty's Castle Library; 979.487, Acc. #898. "Plasterers are inside the Music Room finishing the acoustic plaster, after which they will tackle the travertine special work."

TREATMENT ALTERNATIVES

This focus of this assessment is on setting limits, parameters and categories for preservation treatments. It is critical that future work be carefully chosen with a firm idea in mind as to the historic appearance of Scotty's Castle, its primary character defining features, and what effect, if any, proposed treatments will have on these significant features.

It is not the intention of this assessment to delve into the chemical composition or scientific analysis of historic stucco or interior plasters used in the construction of Scotty's Castle. That level of investigation and expertise will be best accomplished by an expert or specialist in the field and laboratory analyses. However, it is this author's opinion that the park is, and has been, achieving an extraordinarily high level of general research into the subject of stucco. Much of this information is included in the appendix material of this section. The overall recommendation would be to continue on this course with a solid philosophical position, which is recommended below.

Continue On-Going Park Based Stucco Research (Recommended)

It is critical that the stucco testing program currently being undertaken by the park be continued and be supported by Park and Regional Management. The highly unique nature of the stucco and plaster work at Scotty's Castle demands nothing less. The direction of the research so far has been excellent (see appendix K) and should continue establishing a basis for actual replacement of the most severely damaged exterior stucco. Based on the testing program, all replacements would then be accomplished in a manner that would come the closest to matching the original or weathered texture and color, depending on the type of repair.

Stabilization / Reattachment of Damaged Stucco (not recommended)

There have been discussions in the past of re-anchoring the existing stucco that has lost its key⁶⁷. Due to the location of the most severe damage, (Annex exterior first floor, Annex Alcove) and the type of finishes involved, this type of treatment is not recommended. However, if funds do not allow other treatment alternatives, then reanchoring the wall on a temporary basis, with exposed acrylic gussets could be explored if safety is a concern. The problems with this reanchoring approach are as follows:

1. In nearly all the situations that would require extensive stabilization, the stucco has no existing steel lath to reinforce it. The concern would be that attempts to reanchor the stucco may create additional damage to the stucco being reanchored, because there is nothing to hold it together (i.e. lath).
2. As stated in the referenced memo,⁶⁸ there are very likely loose particles of stucco between the stucco and the substrate. Their presence would seriously complicate any attempts to draw the stucco back into its original position.

⁶⁷. Memorandum, Branch Chief, Williamsport Training Center, to Superintendent, Death Valley National Monument, March 29, 1982. See copy of this report in the Appendix of this report.

⁶⁸. Ibid

3. All of the original cracks would remain, continuing to leave the wall susceptible to moisture penetration. In fact, additional cracking would probably result from this treatment, exacerbating the problem further.

4. There would be a considerable visual intrusion created by the introduction of the gussets and probable additional cracking.

Restoration of Damaged Stucco and Plaster (Recommended)

There are several walls and ceilings, as previously mentioned, which will require complete replacement of the stucco or plaster after removal of the original loose material (see figures 23, 25 and 26).

<u>Location</u>	<u>Treatment</u>
North Wall of Annex	Remove delaminated and loose stucco, install new lath system and duplicate historic rendering.
South Wall of Annex	Dismantle delaminated wall areas, rebuild with new system and duplicate historic rendered appearance.
Ceiling and Walls of Alcove and Refrigeration Room	Remove loose stucco/plaster, install new lath system and duplicate historic rendering.
Freezer and Refrigerator Rooms	Dismantle cork/plaster system, reinstall system with positive connections and new lath to duplicate historic rendering.

North Wall of Annex. In this location, the stucco was historically applied directly to the concrete after it had been coated with a bituminous material. The bituminous coating is a potentially weak attachment for the stucco; therefore it would be wise to improve on the installation detail as long as the new work would render an appearance duplicating the historic one. The following steps are recommended to remedy the problem.

1. Remove all stucco that has lost its key to the substrate. This would leave the bituminous layer coating the concrete exposed. Clean the bituminous coating and apply a primer and primer sealer.

2. Install new galvanized steel lath by fastening it to the concrete in a very positive manner (i.e. with epoxy mounted concrete fasteners). This will allow the historic bituminous coating to remain as a vapor barrier.

3. Install a new four coat stucco that matches the original composition, color, and texture as closely as possible. (using the technical results of the three year stucco study being conducted by the park). The areas to be stuccoed should be carefully considered in terms of where new work joins with old work. It may be necessary to remove portions of sound historic stucco in order to terminate the work at an appropriate visual location.

South Wall of Annex, also East Wall of Garage at Refrigerator Room. The finish wall treatments in these areas are separating from the concrete wall much like the north wall. The

exception, as previously noted at the Annex south wall, is the fact that the stucco was applied over a three inch thick hollow tile backing and another three inches of insulex (see typical wall figure 7). In some cases the stucco and tile assemblage have peeled away from the concrete, taking the steel window sashes with it. It is impossible to know how or if this assemblage is anchored to the concrete, although it is doubtful there is any real mechanical anchoring.⁶⁹ It is also likely the bituminous coating is present on the outer face of the concrete. The following steps are recommended to remedy the problem:

1. The loose stucco, tile, and insulex should be carefully dismantled and removed from the concrete superstructure. The hollow tiles and insulex should be removed in a manner that enables them to be reused if possible. The insulex can be cut into large cubes as it is removed (as has been demonstrated on the Cook House). There are many unknowns about the construction of this wall that should be answered and documented when the wall is dismantled. After the hollow tile is reinstalled on the concrete wall, it should be mechanically anchored directly to the concrete in a very positive manner, (i.e. epoxy concrete fasteners) with the insulex sandwiched between it and the concrete. Existing window sashes and door lintels will have to be reinstalled after the tile and insulex are set in place.

2. Galvanized steel lath should be installed on the outer surface of the clay tile wall surface after it has been anchored positively to the concrete.

3. A four coat stucco application would next be installed over the steel lath using techniques and mixtures based on the current testing program. This stucco should match the original texture, color, and composition of the original material as closely as possible. It may be necessary to remove some good historic stucco in order to terminate the work at an appropriate visual location.

Ceilings and Walls of Garage and Refrigerator Room. Much of the plaster on the ceilings has already fallen or been removed previously for safety reasons. The bituminous coated concrete is exposed at the ceiling and it is assumed the walls are detailed in a similar manner.

1. All remaining loose material should be carefully removed along with all stucco that has lost its key to the substrate. This would leave the bituminous layer coating the concrete exposed. Clean the bituminous coating and apply a primer and primer sealer.

2. Install new galvanized steel lath by fastening it to the concrete in a very positive manner. This will allow the historic bituminous coating to remain as a vapor barrier.

3. Install a new four coat plaster that matches the original composition, color, and texture as closely as possible. (A new testing program including this interior plaster should be initiated by the park, similar to the one underway for exterior stucco.) The extent of areas to be replastered should be carefully considered in terms of where new work will join with old work. It may be necessary to remove some good historic plaster in order to terminate the work at an appropriate visual location.

69. Memorandum from M.R. Thompson, to A.M Johnson, July 8, 1928, Scotty's Castle Library 979.487 N, Acc. #898. "We believe that cement mortar would not have held brick in place more firmly than the insulex held the tile to the cement wall. This shows what tremendous strengthening effect the insulex will have in all the walls of the building."

Freezer Room Plaster. The plaster in this room is severely damaged and should be carefully investigated to see if it is still positively attached to the cork substrate.

1. The loose plaster and cork should be carefully dismantled and removed from the concrete superstructure. The cork should be removed or left attached, depending on its condition, after removal of the damaged plaster, then reinstalled.
2. Galvanized steel lath should be introduced to the outer surface of the cork wall surface after it has been repaired and anchored positively to the concrete.
3. A four coat plaster application would next be made over the steel lath. This plaster should match the historic texture, color, and composition of the original material as closely as possible. It may be necessary to remove some good historic plaster in order to terminate the work at an appropriate visual location.

Repair of the Source of Moisture (Recommended)

(See Tile and Climate Control Assessments also.)

It is critical that the source of past and present moisture damage be completely eliminated prior to any new stucco or plaster work. The tiled second floor deck and Lanai are analyzed in a separate chapter of this report, providing recommended treatment for drainage of the following:

1. The roofs drain directly on the second level tile deck. This greatly increases the amount of water that has to be handled by the existing scuppers and adds to wall splash-back.
2. The lanai fountain appears to be one past source of excessive water, requiring extensive restoration if reactivated.
3. The tile deck itself is exposed to direct weathering and appears, in some cases, to drain directly toward the building.
4. The deck drain at the north end of the Lanai is routed under the raised wood floor of the second floor. This may be the main source of problems for the north wall.

Maintenance of Large Cracks (Recommended)

In the past, large cracks, one eighth to one quarter of an inch, have been successfully stabilized with a clear (silicone) caulking material. Where replacement of stucco is not required, and the stucco has not yet lost its key to the substrate, then it is recommended that this same type of clear silicone caulking be used sparingly on cracks in locations that do not have a high visual profile, i.e. tops of parapet walls. This would stop most of the moisture penetration and stabilize the stucco. If the crack is very large, say greater than one quarter of an inch, then stucco that closely matches should be used for the repair. Smaller cracks, one sixteenth of an inch or less, should be left untreated, as previously discussed.

Installation of Expansion Joints (Limited Recommendation)

For the most part, introduction of expansion joints, in the conventional sense, are not appropriate to the historic appearance of Scotty's Castle, and would be considered an adverse effect. There are, however, several locations where it might be possible to introduce a limited application of this construction detail. The following locations are recommended on a limited basis, in the order of most to least desirable.

1. Intersection of the bridge with Main House and Annex.
2. Intersection of Patio walls with Annex and House, on the inside corner only.
3. The back wall of the Annex (north elevation).

Cleaning and Maintenance of Exterior Stucco and Interior Plaster

There are numerous locations on the exterior where the stucco has been stained by rusting hardware. It is highly recommended that the cause of this deteriorating metal be treated in order to stabilize the discoloration of existing and future stucco (see Metal and Glass Preservation). It is not recommended that rust stains be cleaned from the stucco.

Cleaning the stucco will undoubtedly introduce moisture into hairline cracks, having a detrimental effect. This should only be done on a very limited basis.

Interior plaster should only be cleaned by removing dust and dirt with the gentlest means, i.e. vacuum with a soft brush. Introduction of water must be avoided as it could cause irreversible damage to the plaster surface. Additional recommendations are:

1. Clean exterior stucco only when needed by low pressure water (garden hose). Mild detergent may be used if absolutely required. (Recommended)
2. Cleaning with high pressure water or air, abrasive materials like sand, walnut shells, etc. (Not recommended)
3. Removal of rust staining by any means (Not recommended)

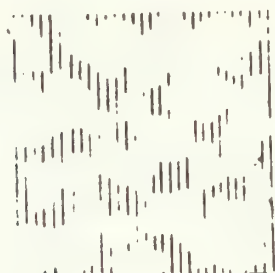
Historic Color Restoration

The color of exterior stucco is to a large extent a product of its exposure to the elements, i.e. ultraviolet radiation, air borne chemicals and pollutants, acid rain. The analysis of historic stucco samples should be performed under controlled laboratory conditions, and a comparative range of Munsell color codes established. Two approaches to color matching are appropriate, depending on the scope of replacement or repair.

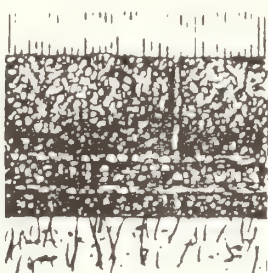
Where entire sections of stucco must be replaced, the new work should not attempt to match the existing deteriorated stucco color, but rather the unexposed (microscopic cross-section) of the sample. All exterior material should be allowed to follow its natural course of deterioration. This is where it becomes important to select a "zone," or limit for the repair or restoration. Match lines (cold joints) should be made at edges or corners. There will be a difference in the color until age

and exposure to the elements have had a chance to effect the appearance of the new work. It is not recommended that new stucco be tinted, or otherwise pigmented to match existing patina. As time passes, it will steadily become closer to the appearance of adjacent sections, rather than increasingly different. The stucco is a sacrificial or weathering layer of protection, much like paint, except it has a much longer life span. The undeniable fact is, that eventually all exterior stucco exposed to the elements will be replaced.

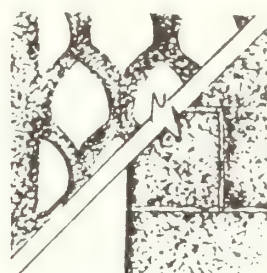
Where small repairs or patches within a larger field of stucco are required, the color of the repair stucco should match the weathered color so it will blend with the surrounding area to minimize the visibility of the repair. In the long run, the entire section will undoubtedly require replacement, and at such time the original stucco color should be used.



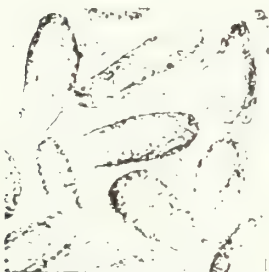
Ext. Weathered
Adobe Stucco, lt.
buff over brown.



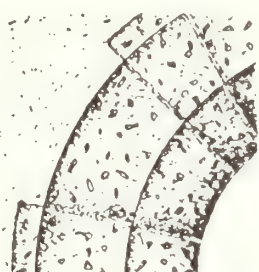
Travertine at base
courses, door trim,
tower stair.



Medium smooth, ext.
stucco, int. plaster.



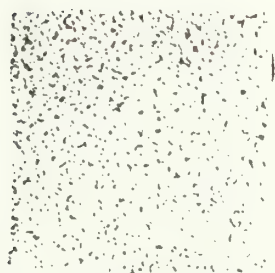
Basmt. Changing
Room. White Int.
plaster



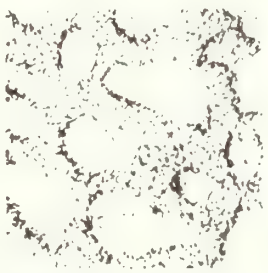
Interior trim plaster,
Upper Music Room.
Lt. Brwn.



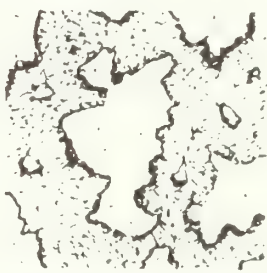
(Latin) Int. plaster.
Very smooth, waxy -
highlights of
rust/beige.



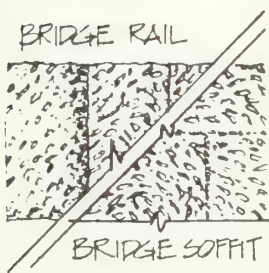
Accoustical Plaster-
Upper
Music Room.



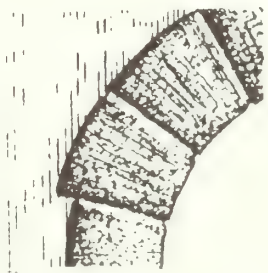
(Spanish) Int. plaster.
Eased edges, white.



(Mexican) Smooth
flat raised portions,
sharp edges, rough
between flat parts.



Decorative ext.
stucco-Heavy texture.

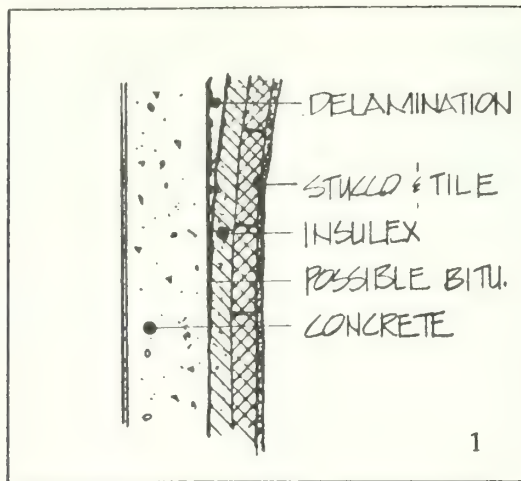


Decorative Ext.
plaster, raked
appearance, Annex
Tower door, brwn.

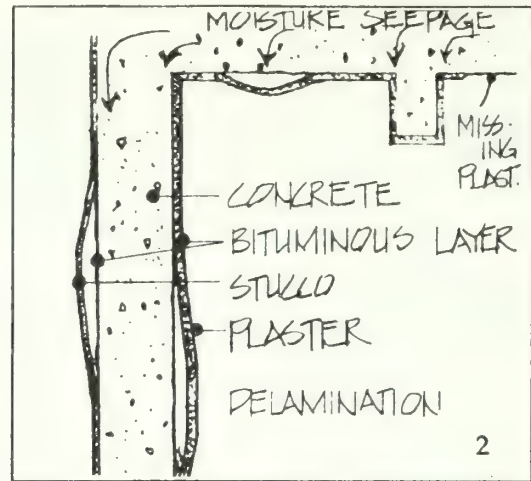


Little or no texture,
color varies, used in
bathrooms.

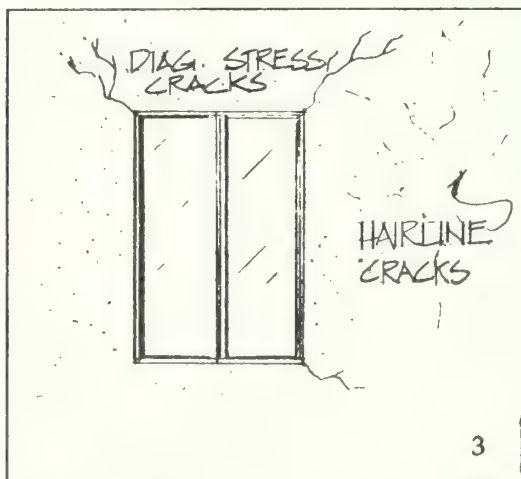
Figure 1: Typical Stucco Textures



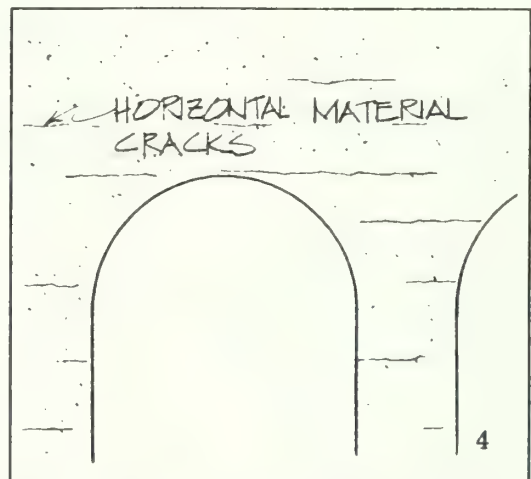
Failure at south wall, Annex - Delamination from substrate.



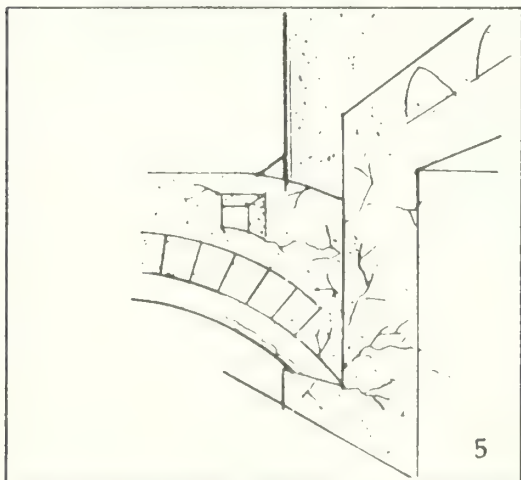
Failure at north wall, interior wall and ceiling, Annex Garage.



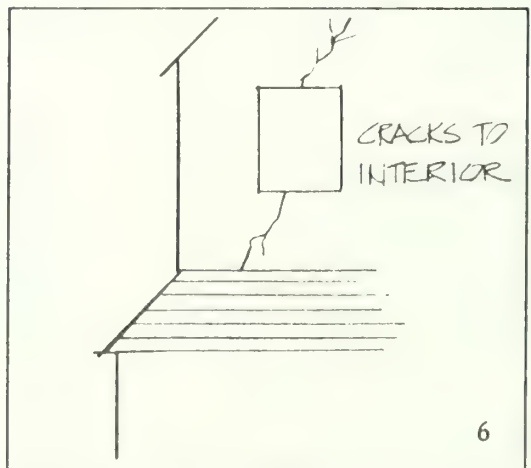
Diagonal stress cracks at openings and general hairline cracking.



Horizontal cracks which follow movement/expansion - contraction of substrate.



Cracks where differential masses intersect.



Cracks at weak points of the structure's framing.

Figure 2: Typical Stucco Failures

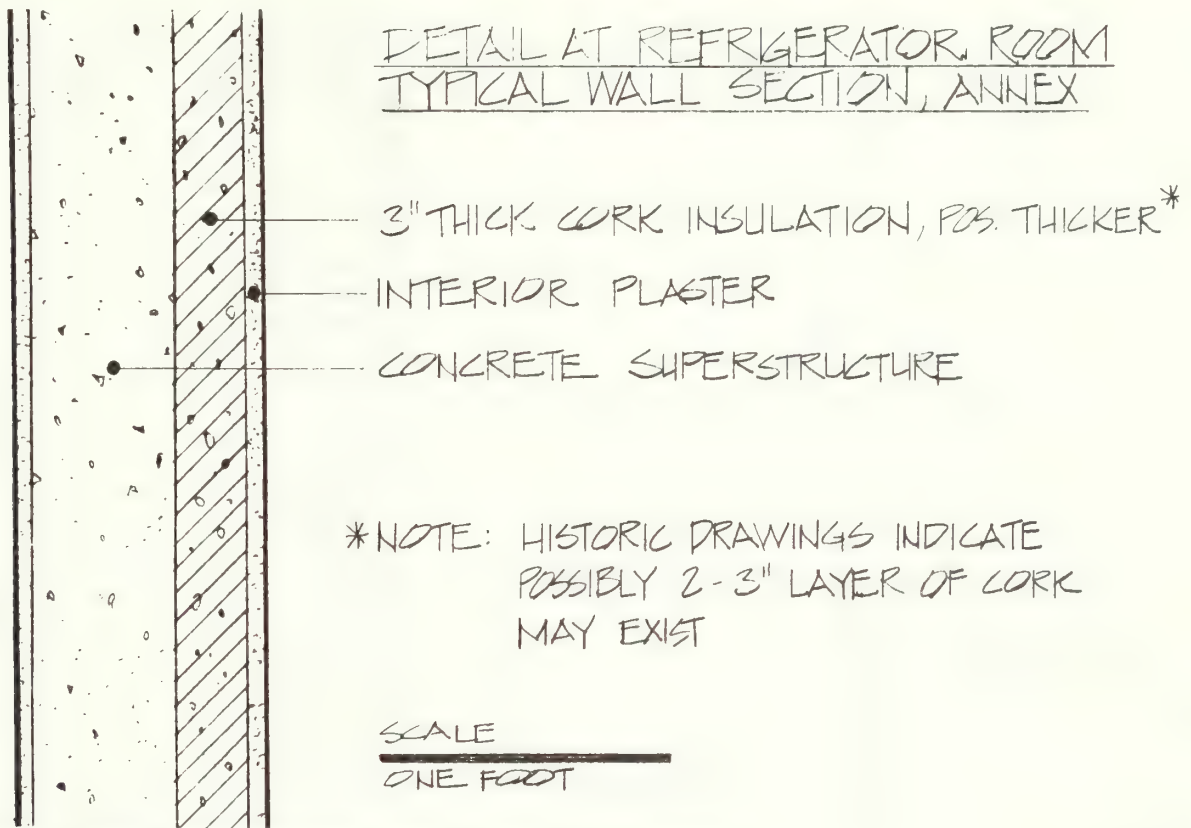


Figure 3: Detail at Refrigerator Room, Typical Wall Section

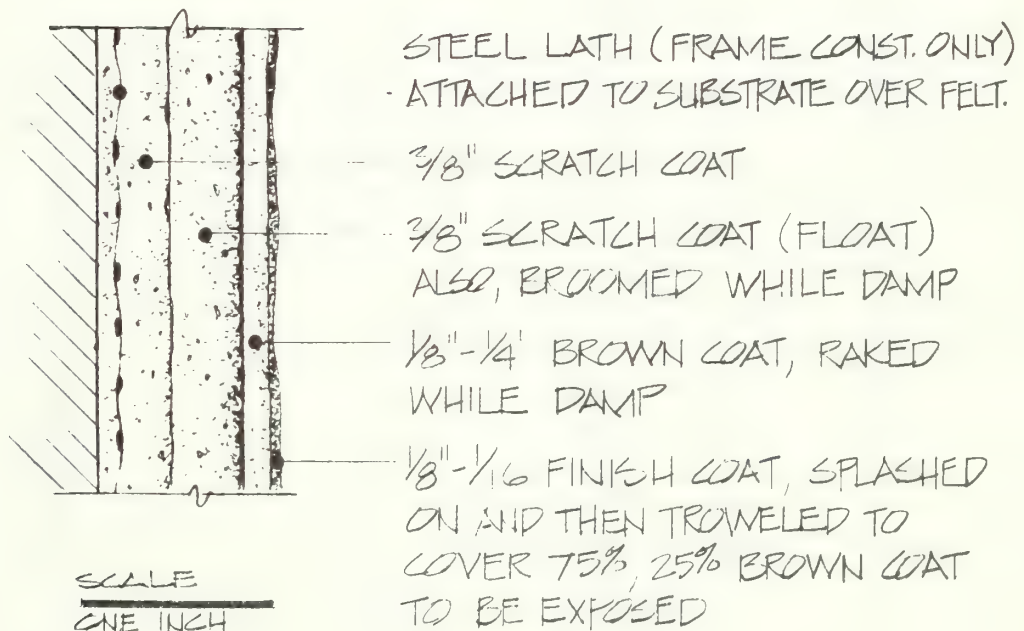
TYPICAL EXT. STUCCO SECTION

Figure 4: Typical Exterior Stucco Section

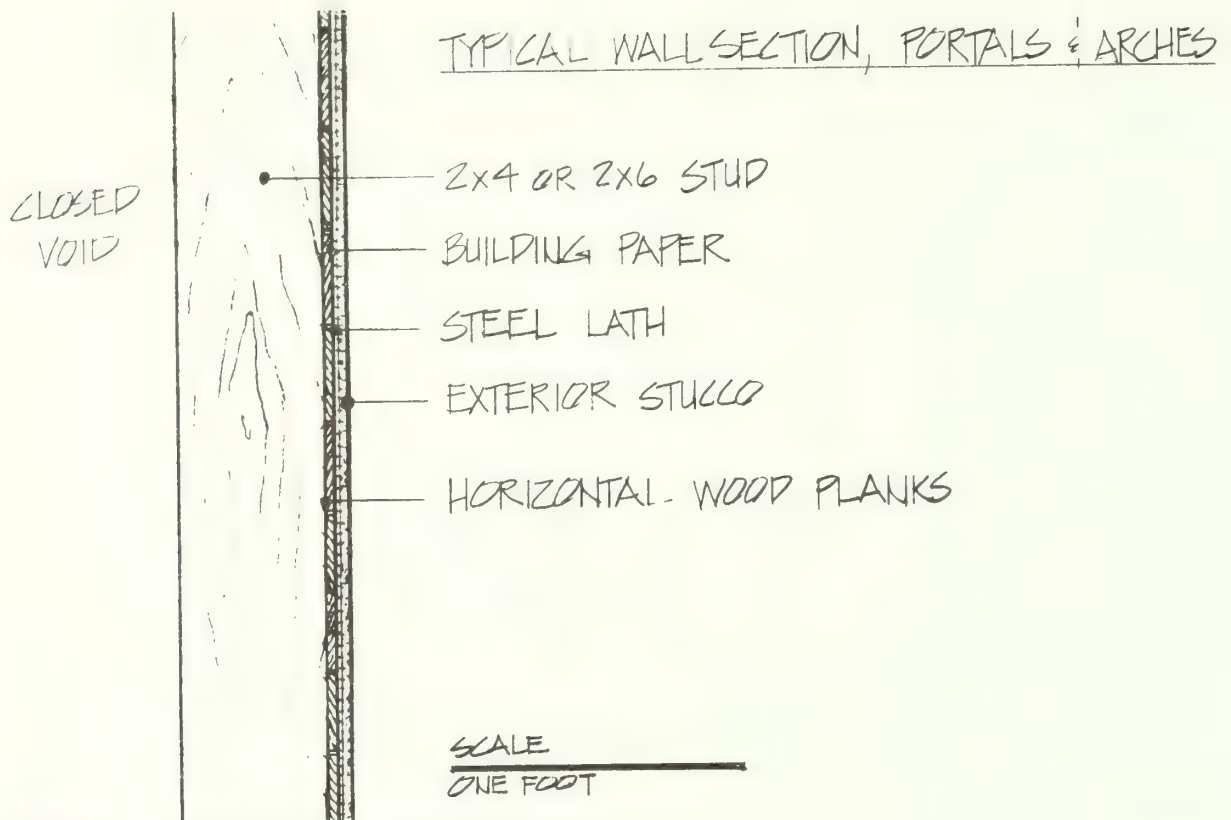


Figure 5: Typical Wall Section, Portals and Arches



Figure 6: Typical Wall Section, Main House

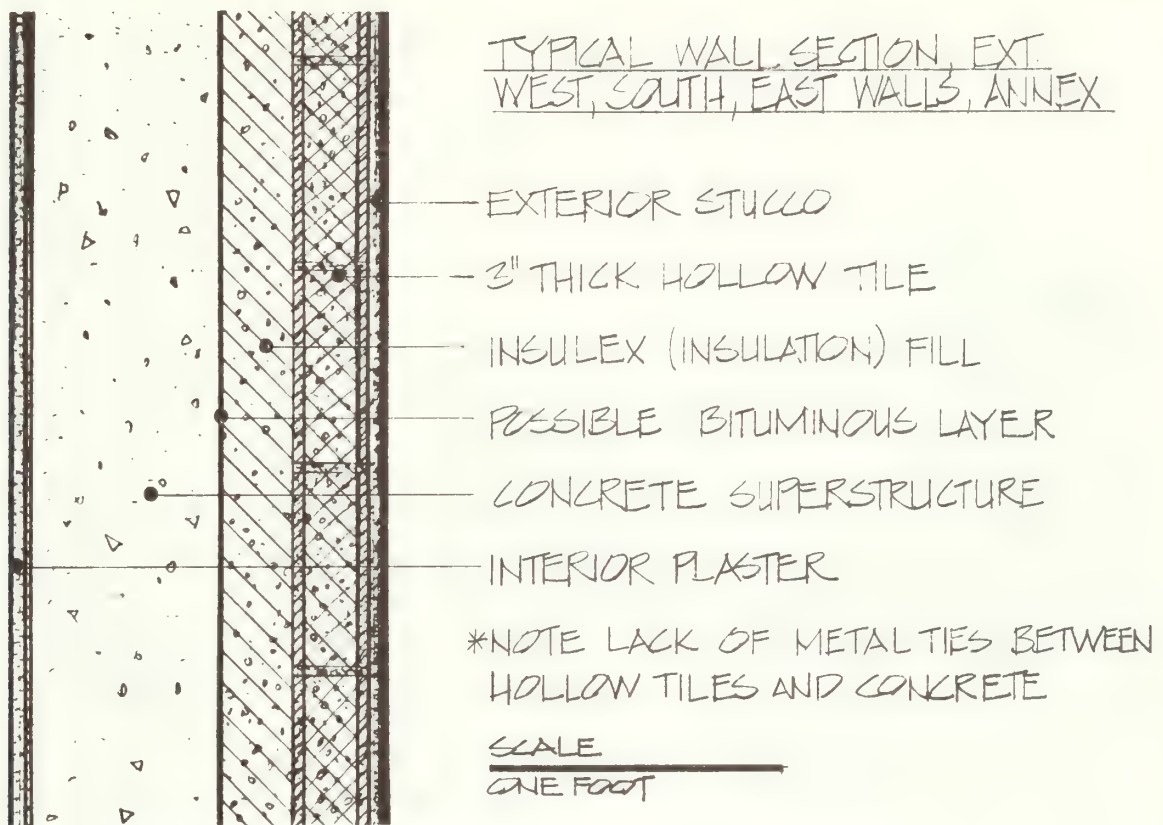


Figure 7: Typical Wall Section, Exterior West, South, East Walls, Annex

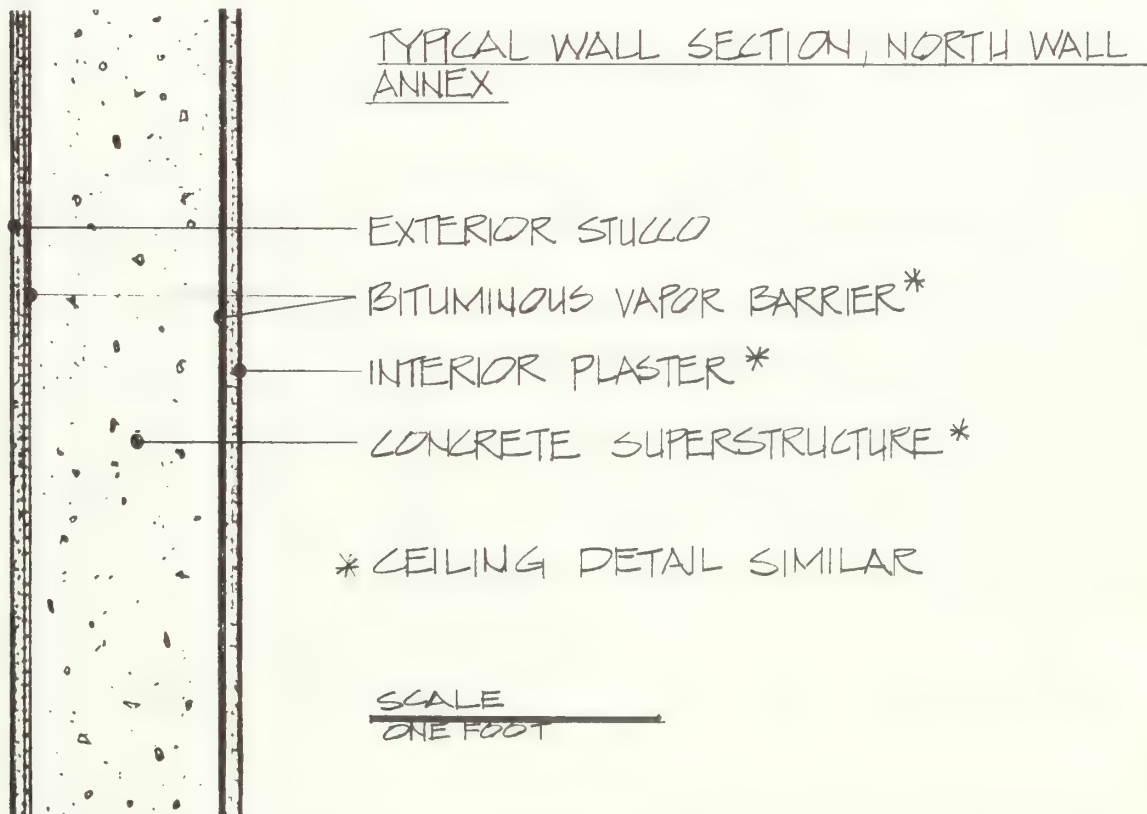


Figure 8: Typical Wall Section, North Wall, Annex



Figure 9: East Elevation, Main House, Annex

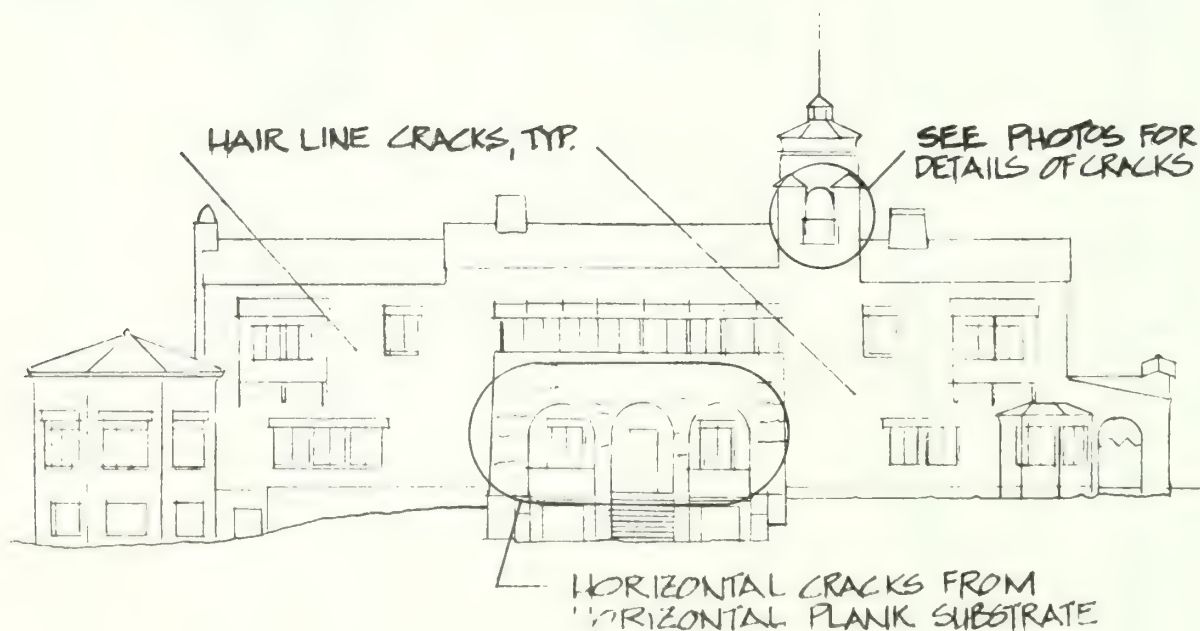


Figure 10: South Elevation, Main House

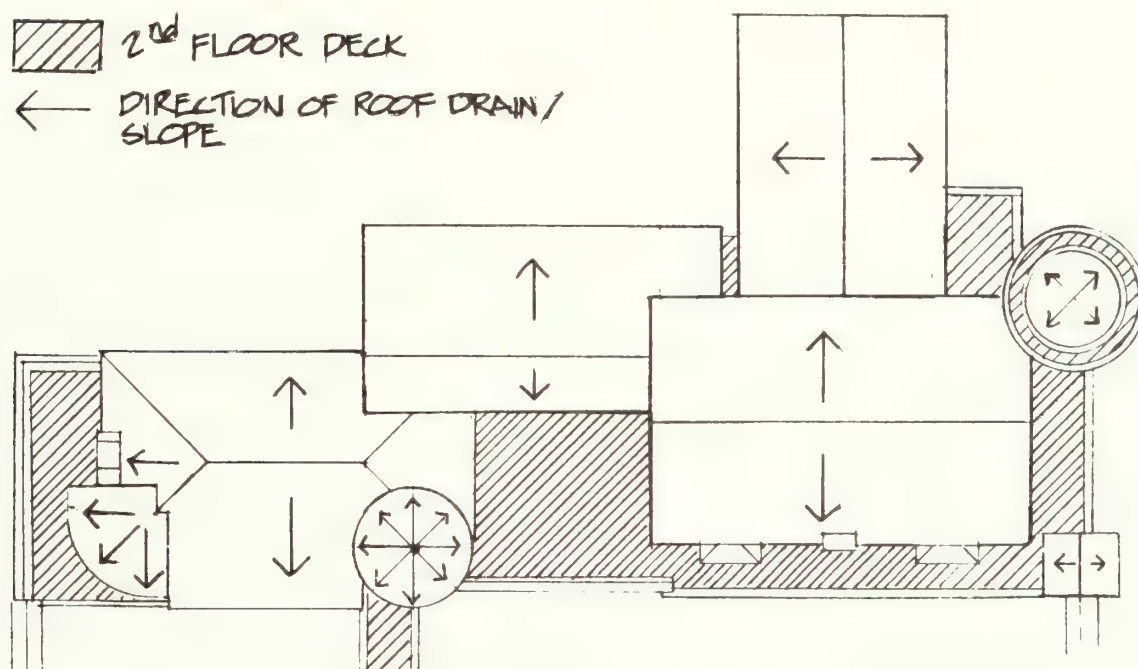


Figure 11: Roof Plan, Annex

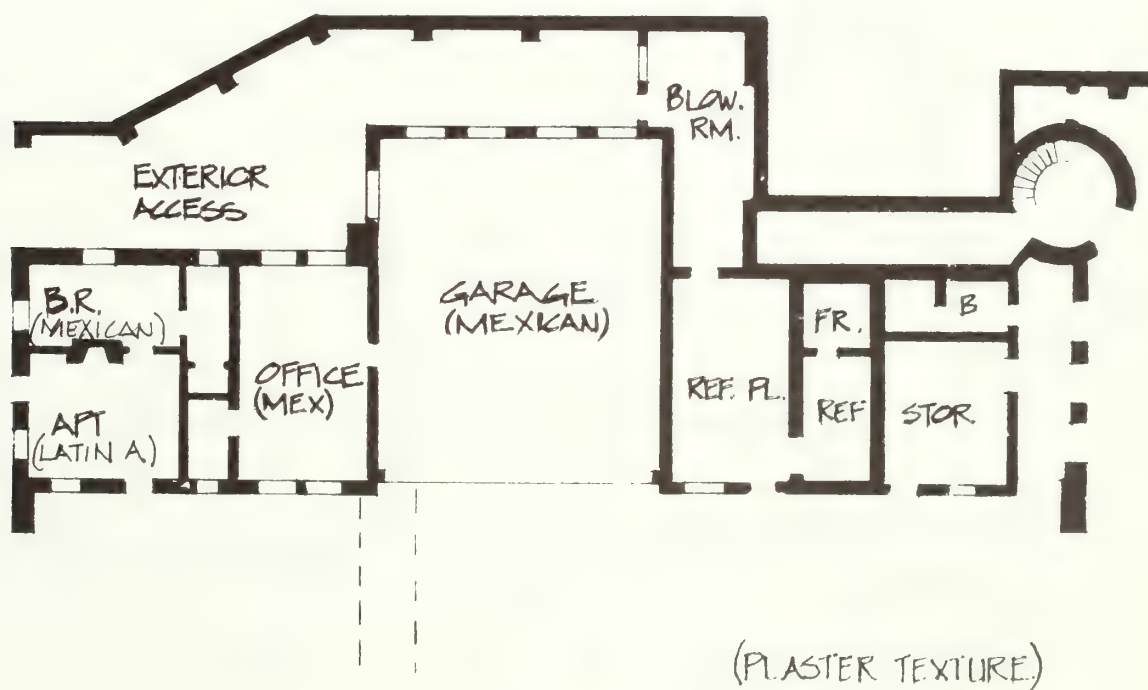


Figure 12: First Floor, Annex

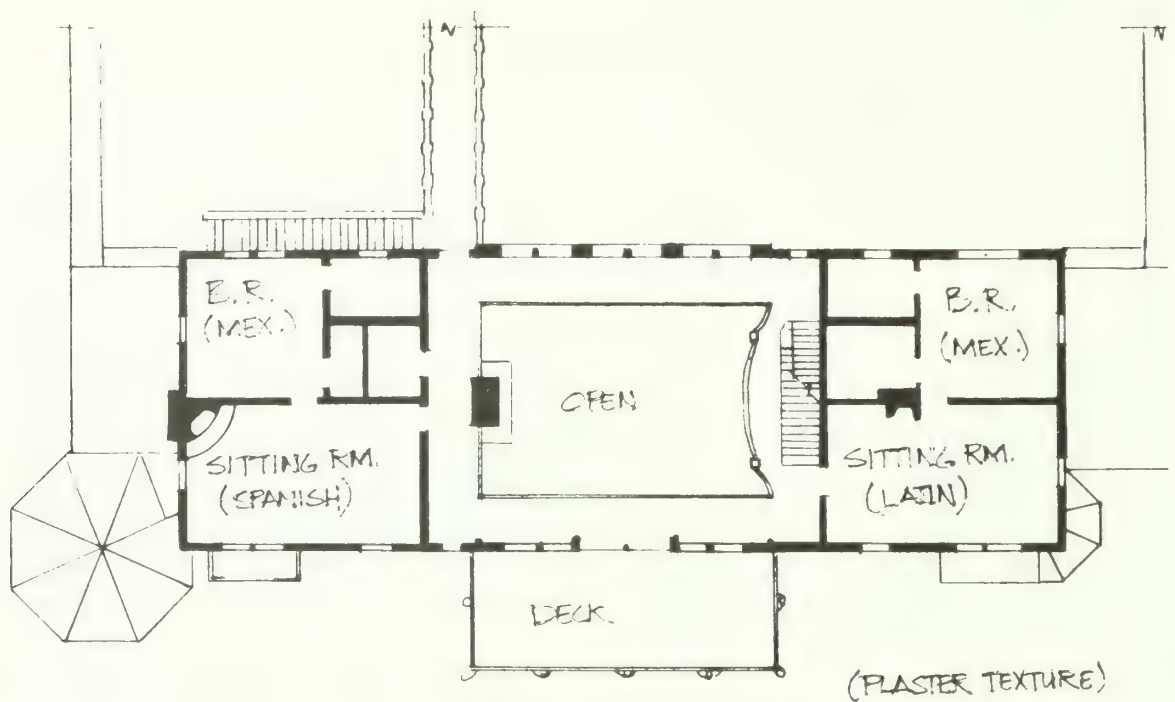


Figure 13: Second Floor, Main House

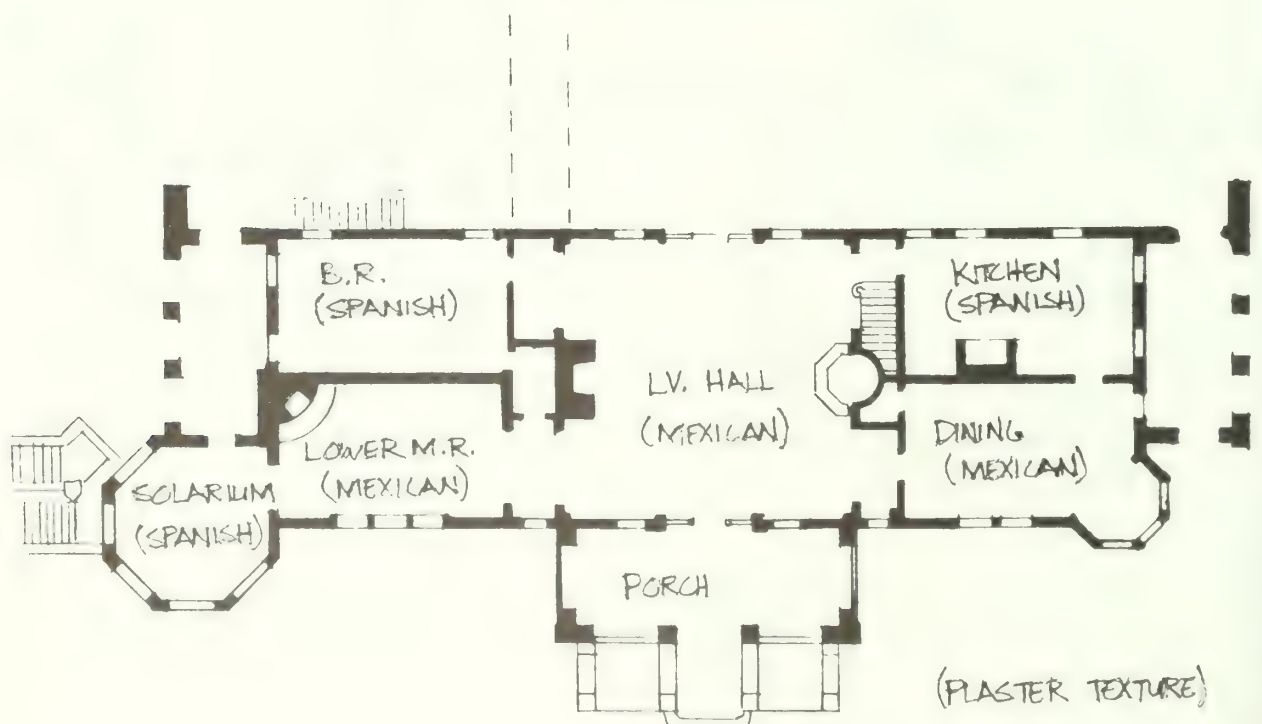


Figure 14: First Floor, Main House

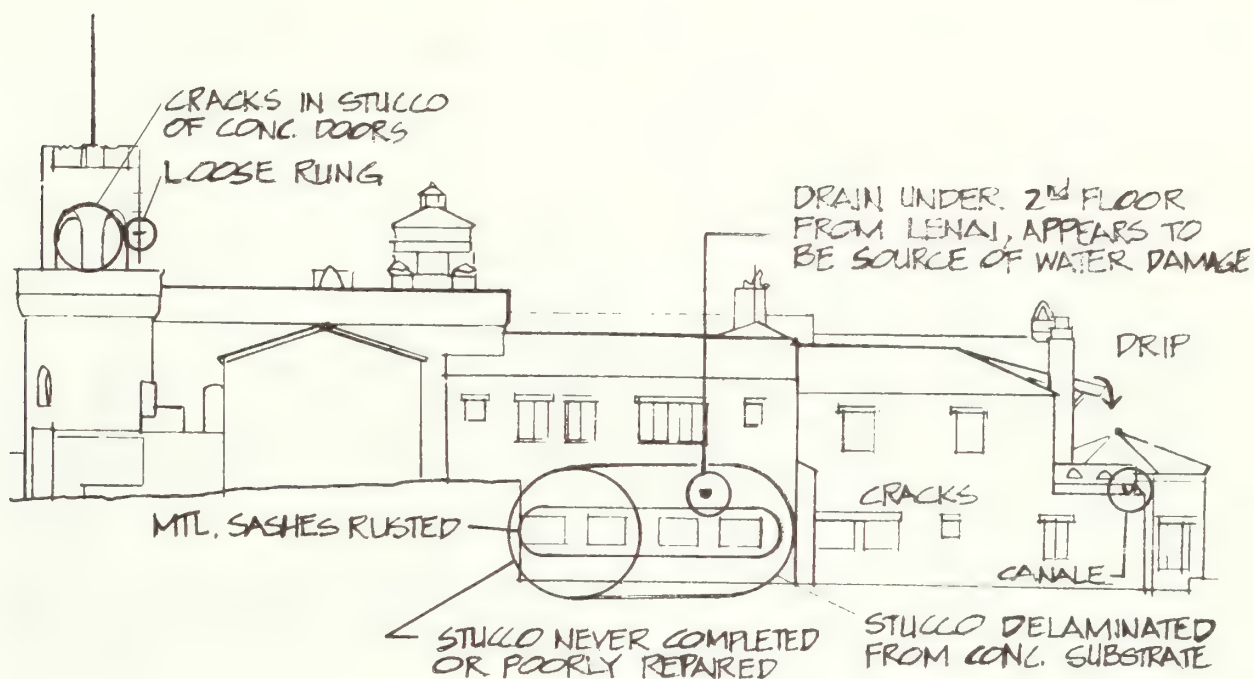


Figure 15: North Elevation, Annex

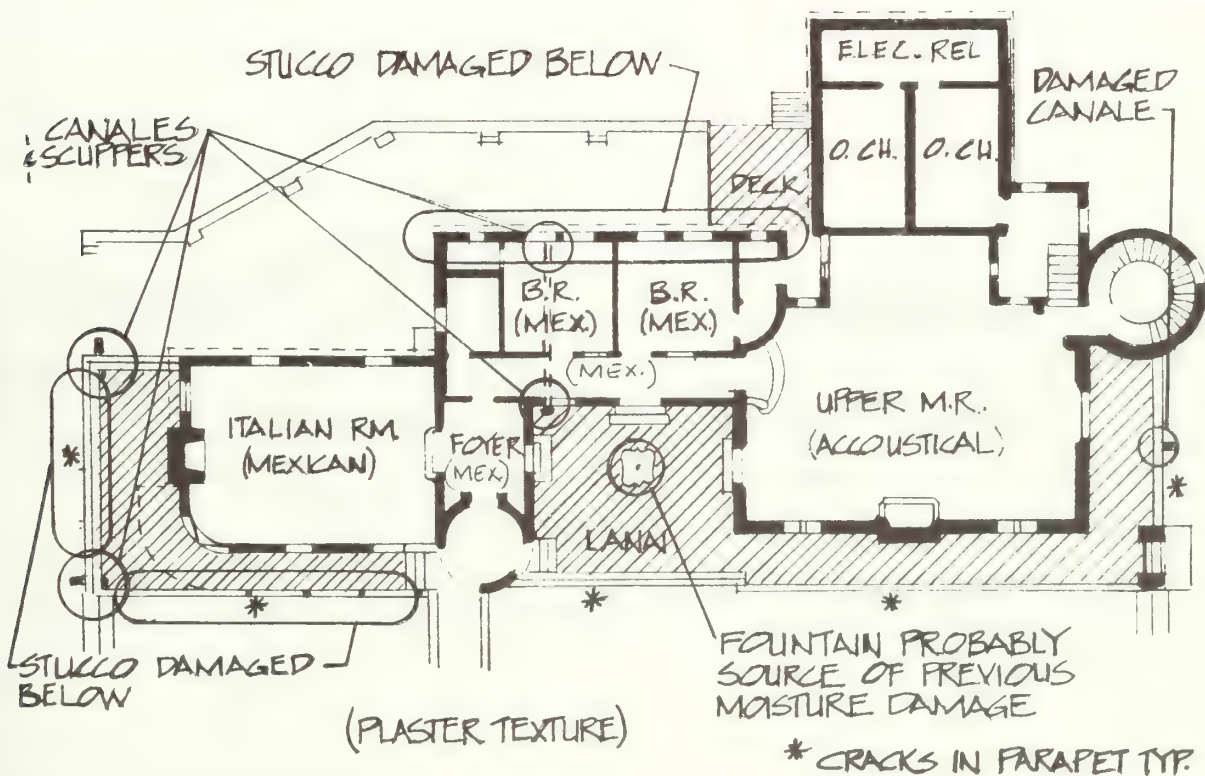


Figure 16: Second Floor, Annex

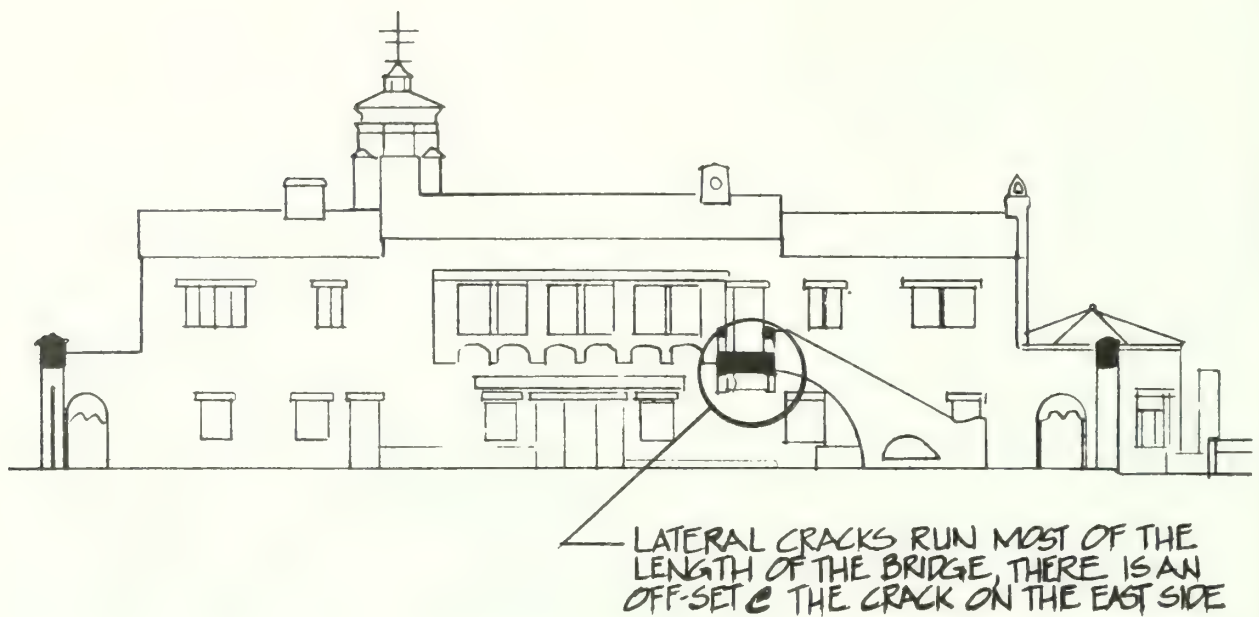


Figure 17: North Elevation, Main House

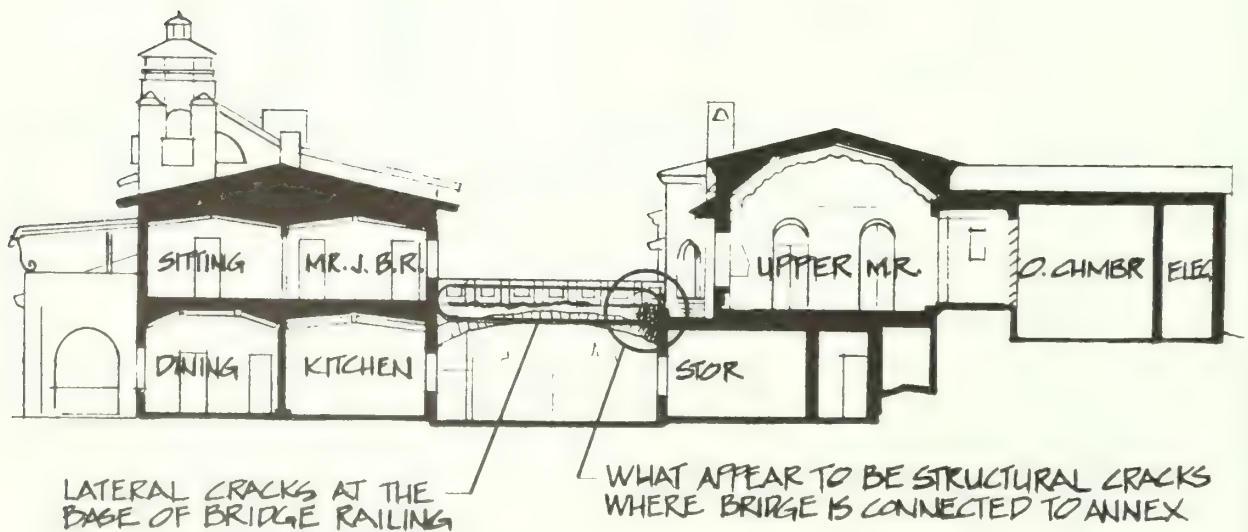


Figure 18: Section East of Bridge, Main House, Annex

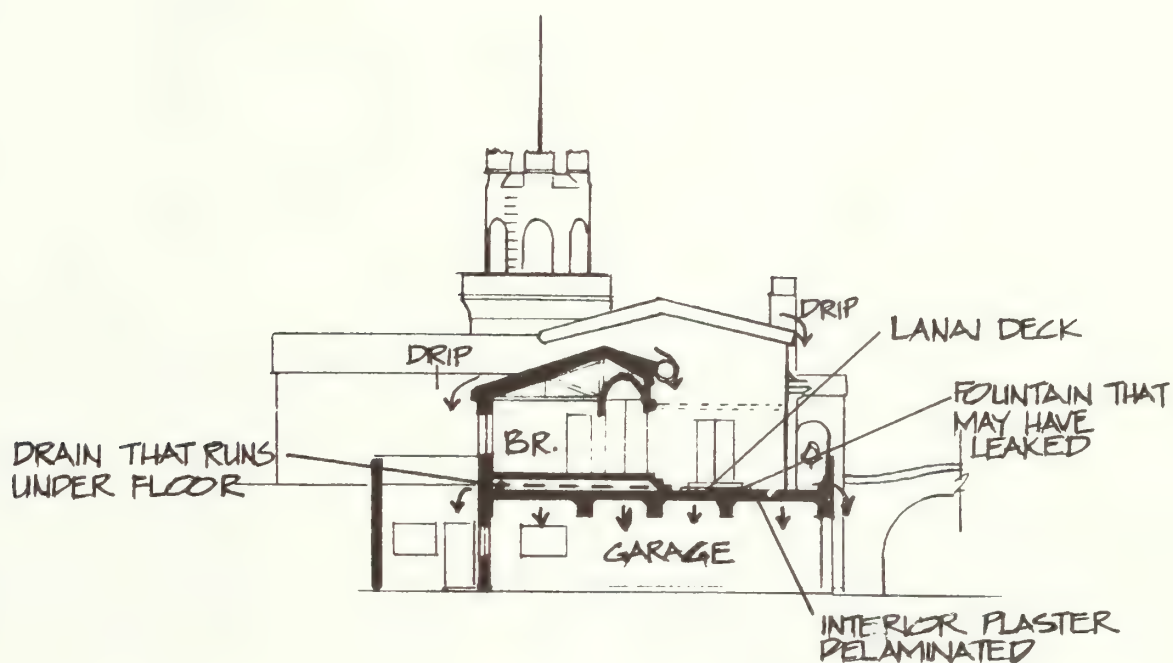


Figure 19: Section at Garage, Annex

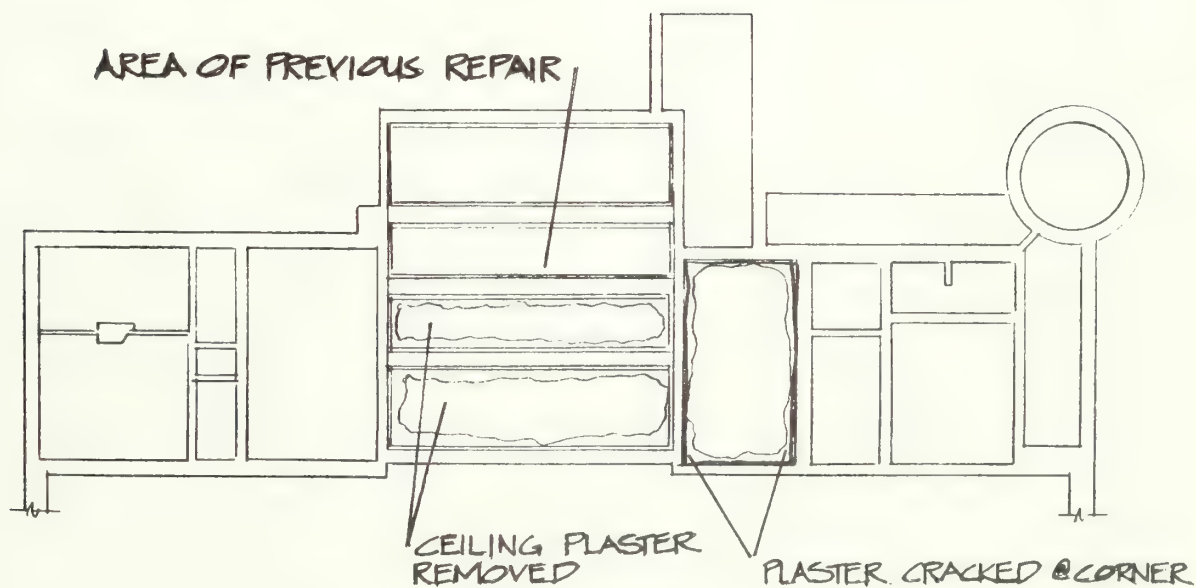


Figure 20: Reflected Ceiling Plan, Annex

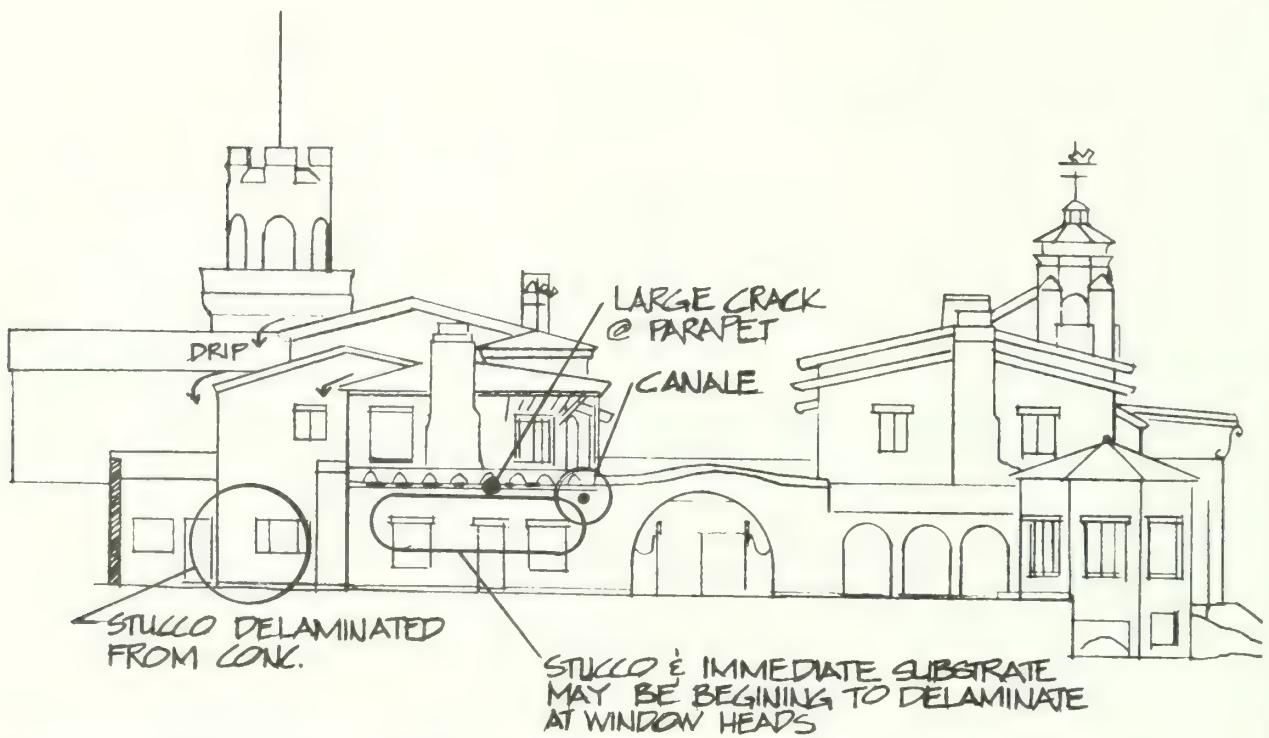


Figure 21: West Elevation, Annex, Main House

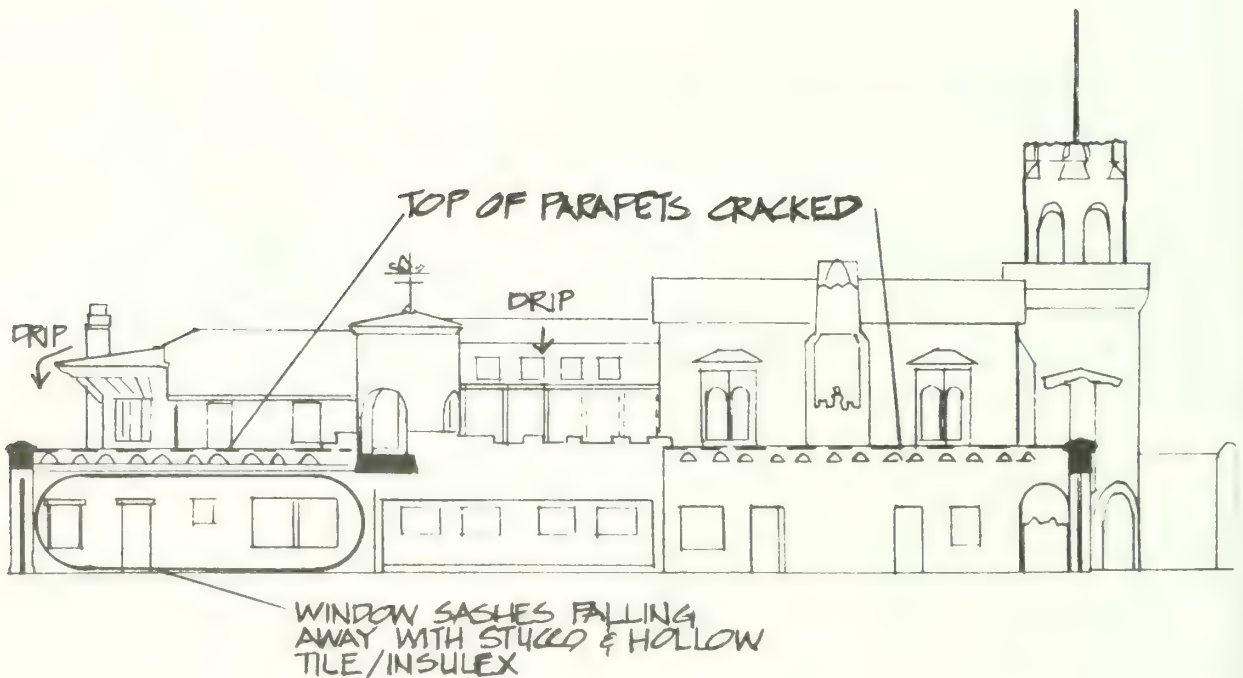


Figure 22: South Elevation, Annex

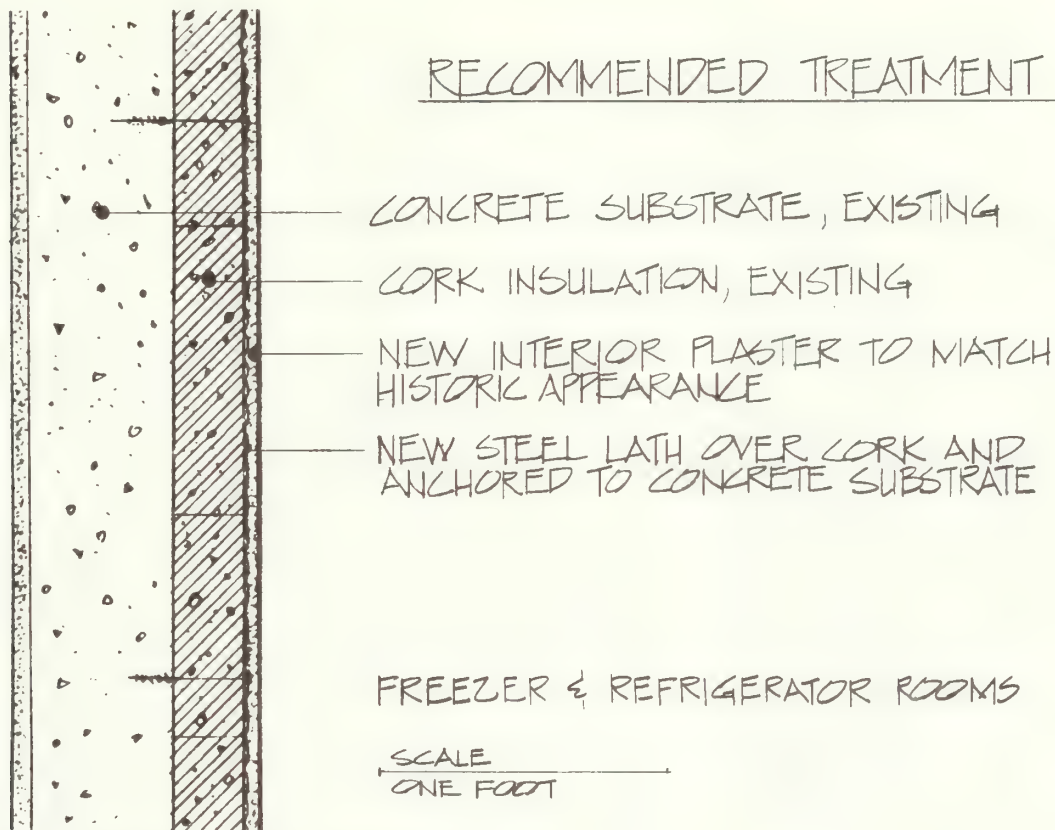
RECOMMENDED TREATMENT C-4

Figure 23: Recommended Treatment C-4

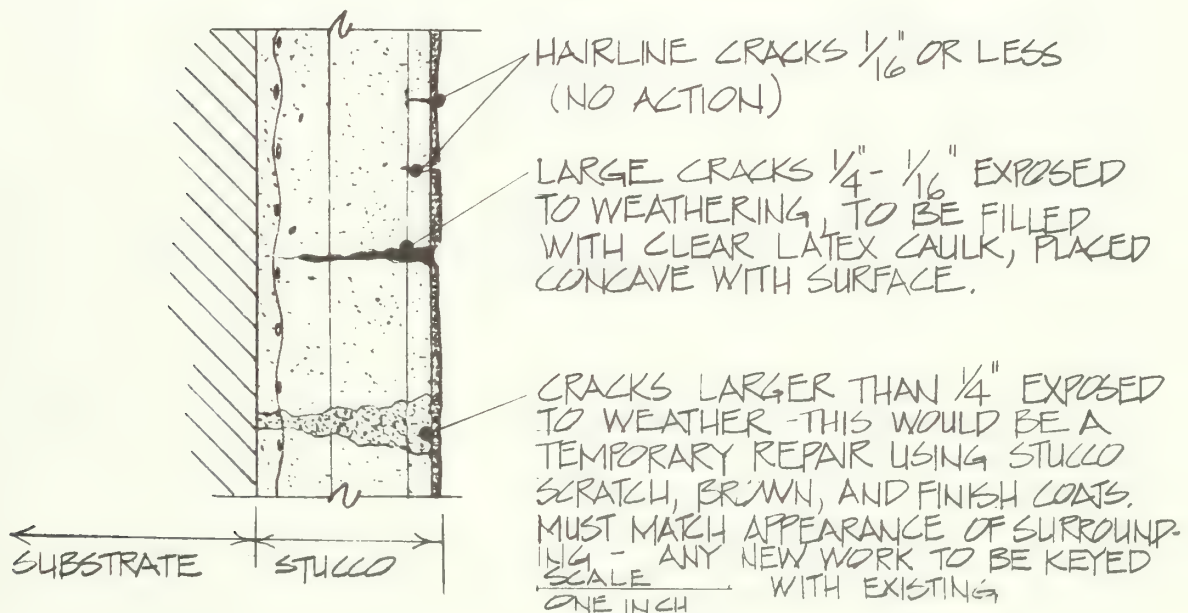
RECOMMENDED TREATMENT E

Figure 24: Recommended Treatment E

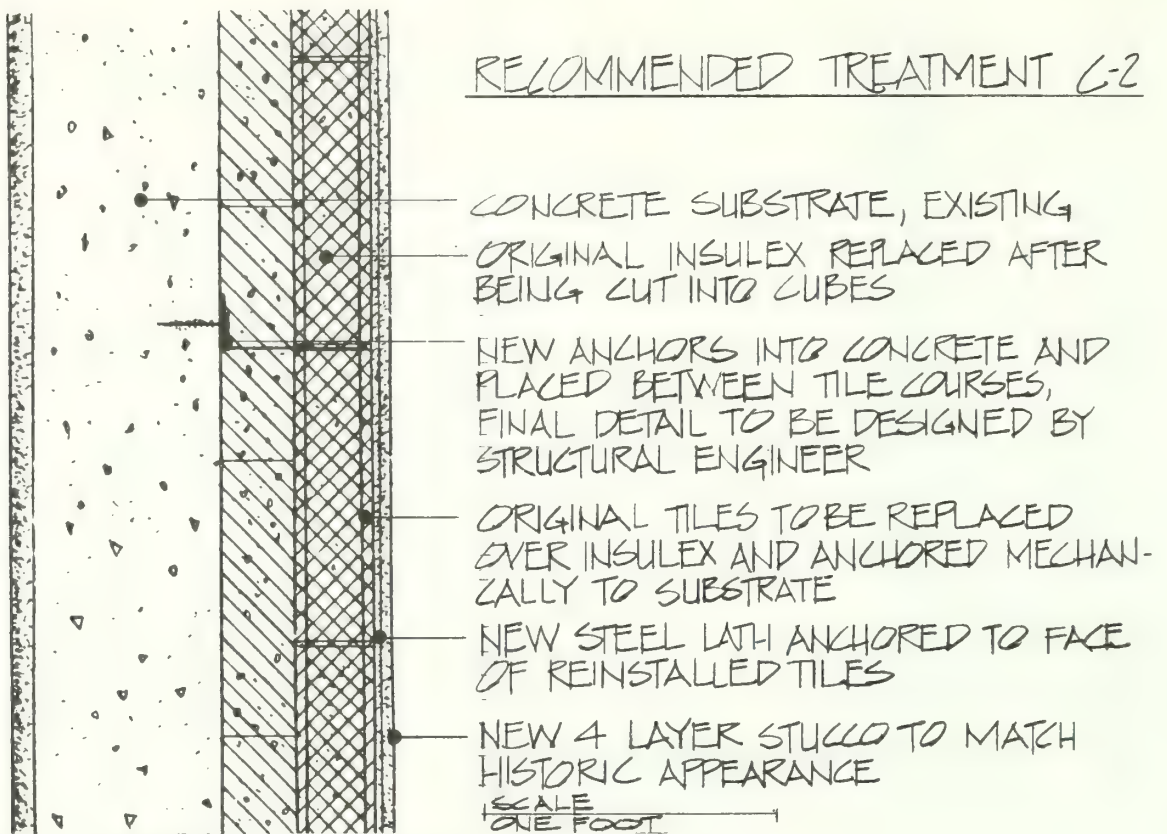


Figure 25: Recommended Treatment C-2

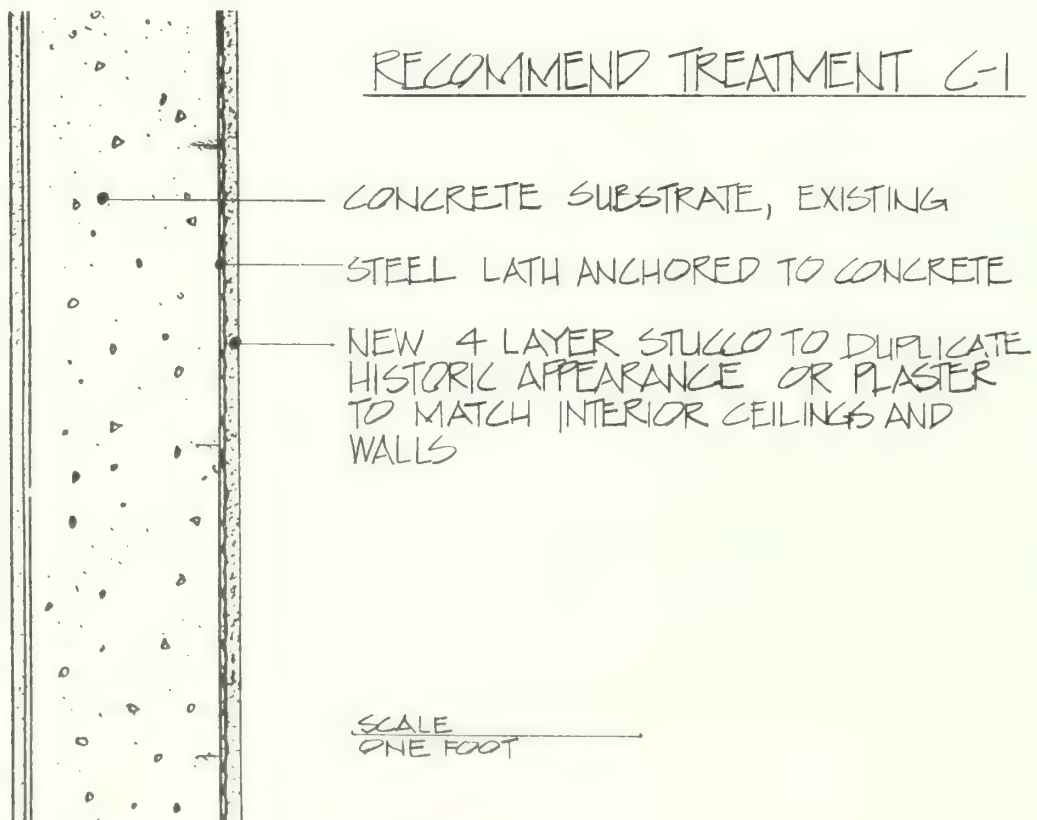
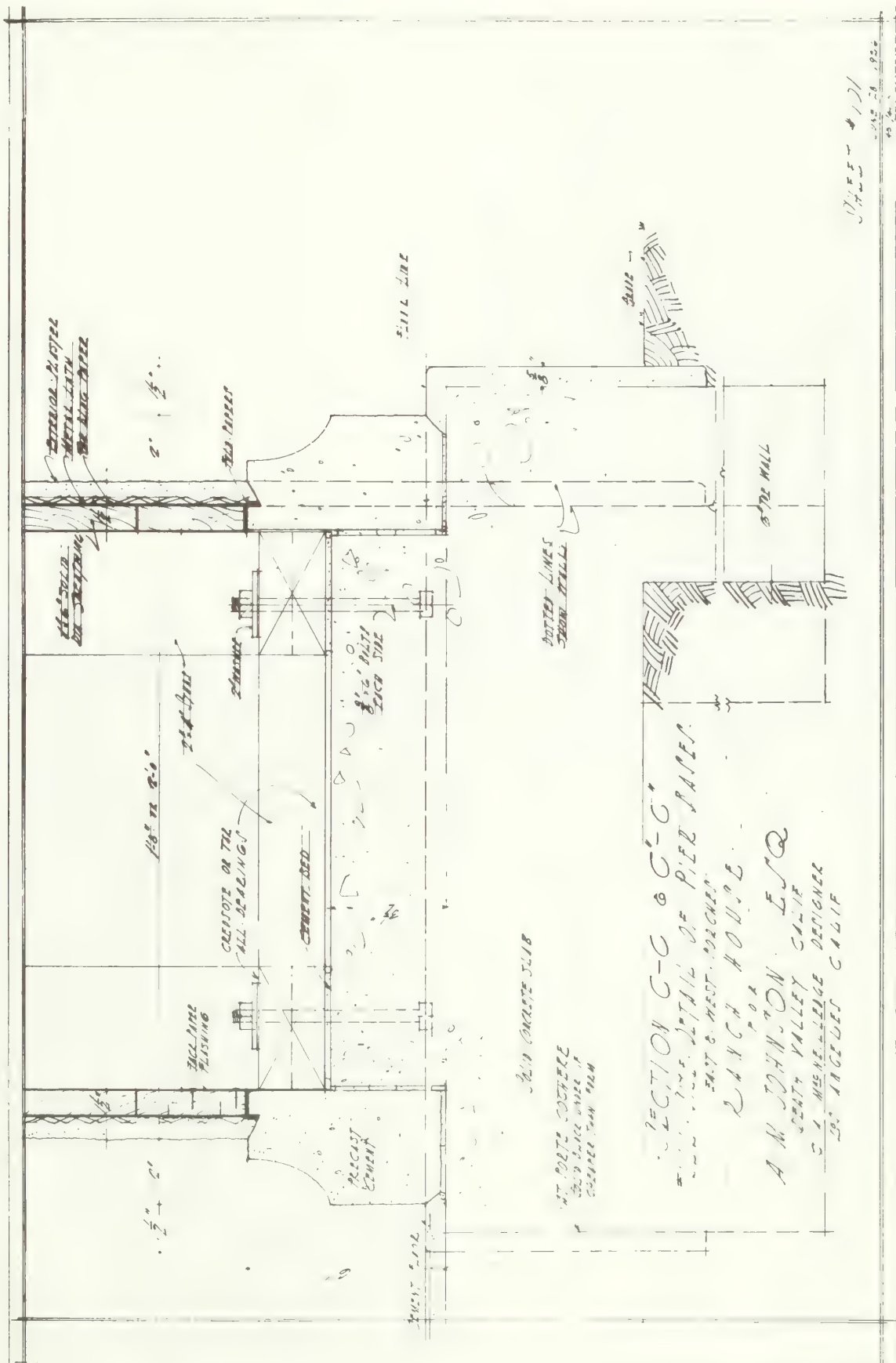
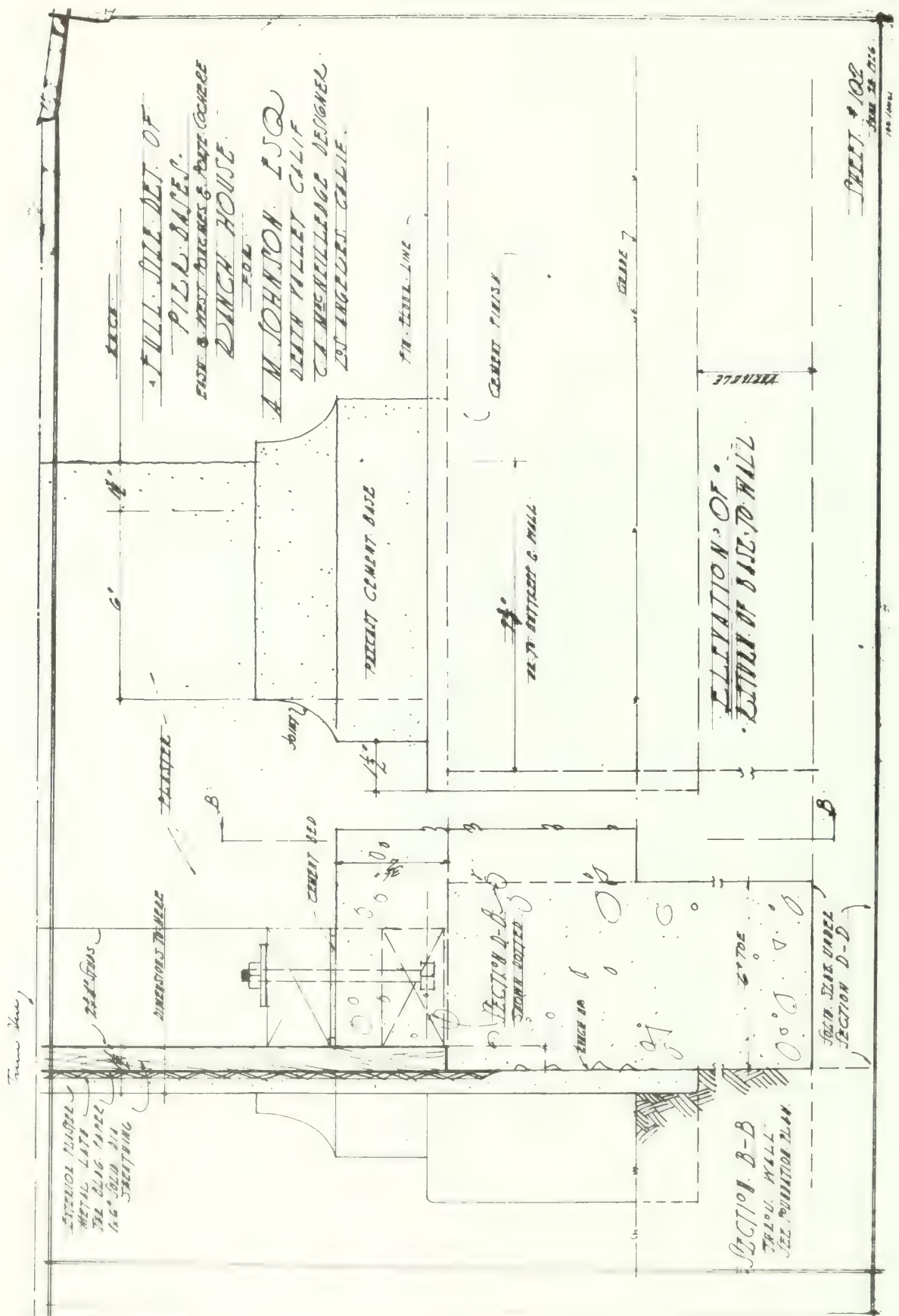


Figure 26: Recommended Treatment C-1





Historic Drawing 3: Detail of Pier Bases, East & West Porches



Historic Drawing 4: Detail of Pier Bases, East & West Porches & Porte Cochere

Photo 1: Annex Tower, top landing at exterior, stucco covered concrete sash.



Photo 2: Annex Tower, detail of hinge connection.



Photo 3: Annex Tower, detail of damaged hinge connection.



Photo 4: Annex Tower, top deck, cracked stucco.



Photo 5: Annex Tower, ladder rungs to roof.



Photo 6: Annex Tower, shutter hinge damage to stucco.

Photo 7: Annex north wall, northwest corner. Note stucco failure at corner.



Photo 8: Close-up of northwest corner illustrated in photo 7.





Photo 9: Annex north wall. Note loss of stucco.

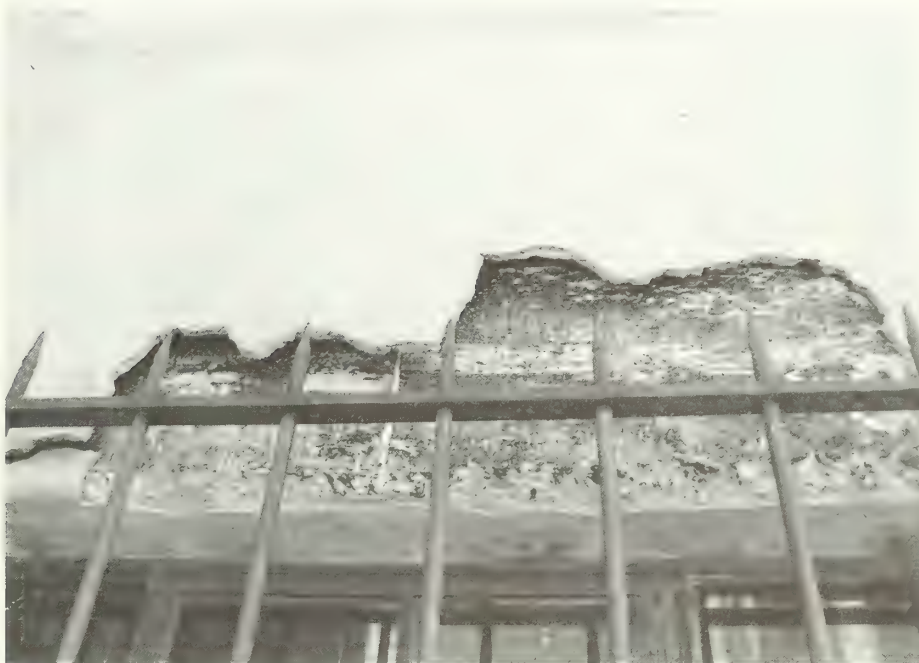


Photo 10: Annex north wall, detail of window head. Note asphalt coated concrete substrate where stucco has fallen off.



Photo 11: Annex, interior wall of Garage. Note evidence of water damage.



Photo 12: Annex, ceiling of Refrigerator Room.



Photo 13: Annex, east wall of Garage, wall is cracked and bulging.



Photo 14: Bridge, looking north. Note longitudinal crack.



Photo 15: Bridge, looking west. Note stress cracks at connection with Annex.

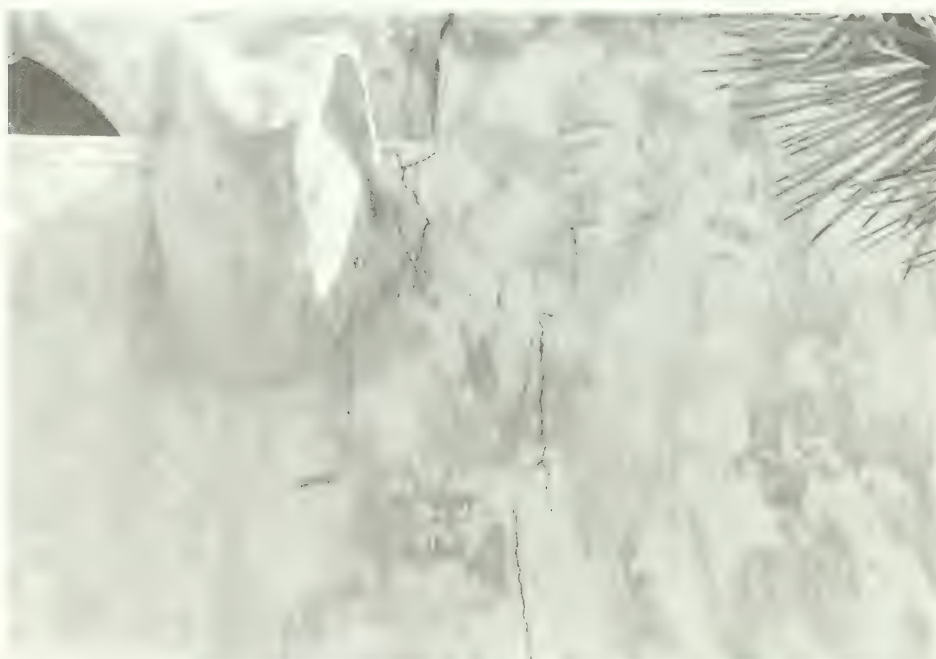


Photo 16: Annex, west elevation. Note cracks where Annex joins with connecting wall.

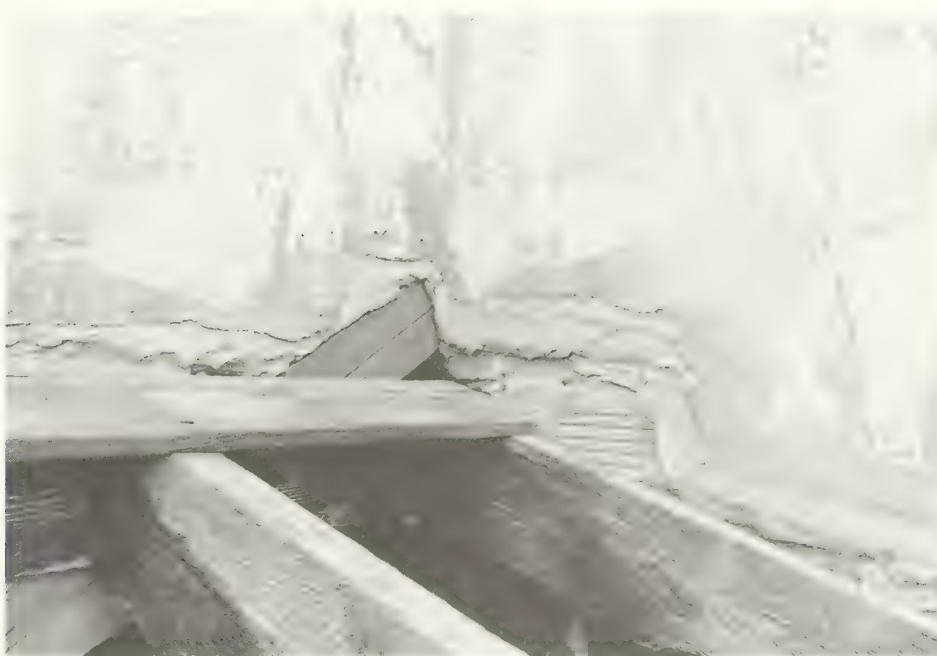


Photo 17: Annex north wall. Note the layers of stucco.



Photo 18: Annex north wall. Note cracking and bulging.



Photo 19: Main house, southeast corner. Note travertine eroding.



Photo 20: Main House, east porch. Note travertine at the base of the wall.



Photo 21: Main House, east porch. Note deteriorated travertine.



Photo 22: Annex, First floor refrigerator ceiling. Note water damage.



Photo 23: Annex, Upper Music Room, detail of damaged sill.



Photo 24: Annex, Upper Music Room. Note damage to plaster caused by furnishings.



Photo 25: Main House, second floor window, southeast corner. Note crack in stucco at window sill and head.



Photo 26: Sample of "Insulex" removed from a wall.

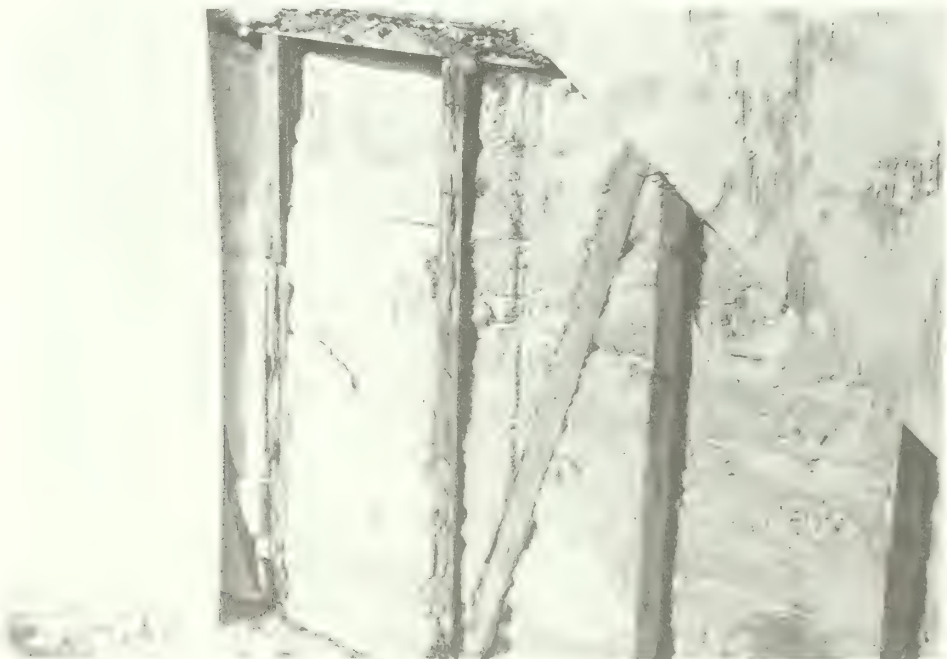


Photo 27: Example of "Insulex" in place with the stucco cut back.

TILE ASSESSMENT

OBJECTIVE

The purpose of this chapter of the Historic Structure Report is to provide documentation, assessment and analysis of historic tilework used on the Main House and Annex of Scotty's Castle. The historic documentation includes types of tile used, the sources (manufacturers), material and process information, and installation information. The purpose of the assessment is to identify conditions and deficiencies. The purpose of the analysis is to determine the appropriate level of intervention (treatment) and recommended treatment strategies.

The assessment of the tilework was initiated during field investigations conducted during the week of February 27 to March 3, 1989. That initial assessment was directed toward identifying documentary materials availability and a basic assessment of exterior tile. Assessment of interior tile and additional assessment of exterior tile was conducted during field investigations the week of April 17, 1989.

DOCUMENTATION

Historic Data

Invoices from the Scotty's Castle records collection provide some informative data and insights on sources of tile as well as other potentially useful material, such as setting instructions sent by the producers. Some of this information is recorded and discussed here in varying detail, depending on the information which can be obtained from the invoices. As additional historic records can be found, pertinent information can be inserted or added, or interpretation presently made may need to be revised. See the appendix L for excerpts from historic correspondence pertaining to tile.

Historic invoices (which had previously been assembled for other research) show three companies that supplied a great deal of tile -- Gladding, McBean & Co., The Spanish Pottery, and the Hispano-Moresque Tile Co., all of Los Angeles. This will be described below. Invoices from Hollywood Potteries did not reveal materials for the buildings, rather it appears that the company supplied tableware, not building material. Two other companies are included in the records, Alhambra Kilns, Inc. and Clarence H. Collings Co., but there was no specific information allowing an interpretation of what was supplied.

Interpretation of Historic Records

The following summarizes the information from the invoices of three major suppliers of tile products for Scotty's Castle. Interpretive commentary is also included. Such interpretation is subject to modification as additional information can be obtained. Addresses shown are those of the historic period as taken from the invoices.

Various tile products were provided by Gladding, McBean & Co., 621 So. Hope St., Los Angeles. Invoices are dated April 1, 1927 through April 30, 1931. These invoices also indicate some products were from their Los Angeles factory, others from a plant at Alberhill.

Flue tile, drain tile, H.T. and gas flue were listed. A translation is needed for the meaning of H.T.

Of particular interest are listings for #1, #2 and #3 "miss pans". A proposed interpretation is that these probably were roofing tile, "miss" meaning mission, and "pans" meaning the inverted or trough pieces. Also listed were "Lg Mission hand made tops", which probably meant the cap pieces, or possibly ridge tile.

Future interpretation of the following listings may reveal some meaningful information:

Junipero top	Marine standard
Palacio	Rd edge R
Commercial	Rd edge L
Hex Palacio	Scum rail, TC
Radical Pal nosed 1 edge; plain	Terra cotta
Dec.	
Dec. Getz B	

A stamp "Junipero" can be seen on roofing tiles; two example locations are on tiles of the west patio gate wall (between the Main House and Annex) and on rake tiles of the Gas House. "Dec." could mean decorative. "Marine standard" and "Scum rail" can readily be taken to mean tiles intended for the swimming pool. Also see the discussion below regarding Spanish tile. There is evidence that "Palacio" refers to the Spanish produced tile for the swimming pool, obtained or shipped through Gladding-McBean.

The second major supplier was the Hispano-Moresque Tile Co., 4283 Beverly Blvd., Los Angeles, with the address of 173 North La Brea, Los Angeles, also listed. The invoices from this company describe tile shipped by the location for which it was intended, in most cases. The invoices are from May 23, 1927 through May 1, 1931.⁷⁰ The following is the listing by invoice date and the description of the tile shipped:

5/23/27	Tile for Bathroom No. 1; decorative, plain colored
8/28/27	Tile for Bathroom No. 2
10/15/27	Annex bath-room, #1 typ. guest bath room; #2 typ. guest bath room
5/23/29	Roof for Chimes Tower
5/25/29	#141 Dec. tile
5/25/29	1 x 6 yellow strips, blue OT. round, #141 Dec tile
7/19/29	4 finials w/colored glazed tile borders for Chimes Tower
5/1/31	All tile for benches surrounding swimming pool

The third and a very significant supplier was The Spanish Pottery, 3959 Goodwin Avenue, Los Angeles, Calif. The invoices from this company are the most detailed and therefore most informative. The invoices date from July 3, 1927 through May 24, 1931.⁷¹ Some invoices indicate that some of their shipments were made "via Gladding, McBean & Co. Car" (see for example the invoice of December 12, 1927). Also note that some orders were by contract, others "as ordered by Mr. C. A. MacNeilledge". A search for and study of the contracts refereed to may yield information on the design and materials of the tilework.

70. DEVA, Scotty's Castle archives, MSS 15, Box 2, Folder 2, Box 6.

71. DEVA, Scotty's Castle archives, MSS 15, Box 3, Folder 3, Book 9.

Review of these invoices shows The Spanish Pottery shipments included tile for the following:

Main House, First Floor

- Base and flooring border, Scott's Bedroom
- Base, Passage to Scott's Room
- Base, Passage to Stair, and stairs [?]

Main House, First Floor (cont.)

- Base, "alcove adjoining office" [bay of Dining Room ?]
- Entrance porch rails
- Solarium fountain and window surrounds

Main House, Second Floor

- Base for Gallery
- Part of Gallery floor
- Base and part of floor for Mr. Johnson's Room
- Base and floor for "apt. with fireplace"

Several of the invoices for these areas indicate part of the Gallery floor and part of the floor for Mr. Johnson's Room, but do not specifically call out the remainder or all of the floor as in other cases. It is not clear whether the base and floor for the "apt. with fireplace" meant Mrs. Johnson's Room or whether it may possibly have been for the Spanish Sitting Room.

Bridge

- Cap tiles

Annex, Second Floor

- Base and floor, "Living Room" [Italian Room ?]
- Base for passage [Foyer ?] and Hall
- Base for Guest Bedrooms
- Base and floor tile, Music Room and Orchestra
- Music Room frieze, door banks, curved step risers and radiator screens
- Music Room window hoods
- Sun Dial

The Spanish Pottery shipped numerous other "miscellaneous" tile, tile for the Guest House, Chimes Tower, Powerhouse, Pavilion and the swimming pool. Invoices also list "Oronite waterproofing" and "Elseco' process waterproofing". Tile setting instructions were sent, such as "Recommendations Regarding 'Random' Floorings and Pavements at Death Valley Ranch, As Laid With 'Spanish Pottery' Tiles", dated June 21, 1931.⁷²

Evidence from invoices and tile elements themselves provide verification that some tile was obtained from Spain. An invoice from MacNeilledge to Johnson, dated April 24, 1930, was for some Spanish tile purchased by MacNeilledge in the Fall of 1927 which arrived in California in the Spring of 1928.⁷³

72. DEVA, Scotty's Castle archives, MSS 7, Box 38, Folder 5.

73. Scotty's Castle archives, file accession No. 1553, translations of Spanish invoices for fabrics and tile by Karen Duggan, Museum Technician, Death Valley National Monument, 1988.

Some of the tile identified as being produced in Spain and the imprints on the back of them are:

The "Quiote" tiles on the large table in the Great Hall:

CAITULO XV

A. PEDRAZA, TOLEDO, ESPAÑA

Iron and tile benches intended for the pool, which are in the artifact collection:

M. G. MONTALVAN/TRIANA

Planter pots which historically were placed on the Patio and the Lanai, now located on the second level of the Main House front porch are from Triana.

Tiles intended for the swimming pool, including edgings and borders:

A. PEDRAZA, TOLEDO, MORIZ

Tiles probably intended for the swimming pool, 8 inches by 8 inches with a light blue glaze, at least shipped by Gladding-McBean if not purchased through or by them, having the imprint *PALACIO*.

At least part of the tile of the Lanai fountain (see Fountain chapter of this report).

Tile which may also be Spanish are the picture tiles on the splashboard of the Kitchen sink, and the fireplace plaque in the Spanish Sitting Room. The coat-of-arms tiles in the Upper Music Room are thought to be European. These have not been documented as yet.

ANALYSIS AND FINDINGS

Roofing Tile

The majority of the roofing tile is red clay, commonly known as mission tile. Both historic construction drawings and some of the invoices indicate hand made tile was intended and was actually supplied.⁷⁴ Such hand made tile is often thought to have been shaped by the workman using his leg as the "form" by bending the clay slabs over the thigh. This seems to be an accepted explanation for the irregular, tapered shapes, and the non-uniformity of curvature and width, if not also length. Another production technique of hand made tile could also cause these irregularities. After shaping a slab of clay over a wooden mold, tiles commonly would be stacked in rows and on end to dry to leather hard before firing. This stacking would cause the irregular deformations of the tiles.

The curvature and size of later standard production tile does not mesh with the tile at Scotty's Castle. The absence of an identified source for these handmade tiles is the reason that virtually

74. Two historic drawings indicating hand made tile are a Feb. 15, 1927 drawing of the Main House Tower, Drawing No. 143/41029, sheet 10 of 41, and one of Annex elevations, Drawing No. 143/41029, sheet 28 of 41, dated 1927. On the former drawing, roofing tile is specified to be "laid random, eaves irregular, all in cement." Invoices indicate hand made tile as noted above.

no replacement has been accomplished. This difference can be seen in a few places where standard tile has been used temporarily for removed broken tiles.

Two different methods were used for roofing tile installation. First, and commonly associated with this roofing system, each tile has a hole about an inch or so from the upper end and is nailed to the roof framing, or nailers or sheathing, as the case may be. An example of this is at the east porch of the Main House and can be seen from the underside of the roof. The inverted runs are nailed to 4 x 4 purlins. The cap runs are nailed to the 2 x 6 rafters. The nail heads are intentionally left well above the tile (approx. 1/2-inch) to allow for movement and contraction and expansion. The tile is held down by its own weight.

On most roof surfaces, however, a different method was employed. The tiles were set in a bed of cement mortar and furthermore were nailed indirectly – a copper wire was run through the hole in the upper end of the tile to form a loop, which was in turn nailed, using copper nails. A considerable amount of the bedding mortar is exposed. It appears that the tiles are in fact fully lapped and the exposed mortar is simply excess from the setting. However, future investigations should be conducted to determine if this is consistently true or whether there are locations at which the exposed mortar is the only "protection" against intrusion of water into the roof system. The mortar certainly adds considerable additional weight to the roof. Detailed investigation and inspections should be done only when a satisfactory method is available to protect the tiles from breakage.

The mission tile roofing is in fair condition but does need attention. Numerous tiles are cracked; some are broken but still in place; portions of broken tile have been dislodged; a few are completely out of place or are missing. In some places ill-fitting standard tiles have been inserted or are simply laid in place as a temporary measure. East and north facing roof surfaces seem to be in better condition than south and west facing.

Some examples of roofing tile deficiencies can be observed adjacent to the Main House Observation Tower where there are cracked, broken and displaced tiles. Several newer tiles have been laid in for temporary protection. There is also a chunk of displaced mortar here. This damage has probably resulted mainly from walking on the roof as it is easily accessible here from the Observation Tower. There are missing and broken tiles on the Dining Room bay. On the west porch of the Main House one can observe a number of broken tiles. Another example is on the Solarium roof where there is a missing ridge tile on one of the ridges next to the Main House wall.

Tile bedding mortar needs to be investigated where it is exposed. This mortar is cracked in many places and a determination needs to be made as to whether these cracks admit water into the roof system. If the tiles are adequately overlapped the exposed mortar cracks are probably not a significant problem. If, however, the exposed mortar is in itself the roof protection, then any cracking or breakage is allowing water to penetrate the roof system.

Another possible condition should be investigated when practical to do so. There are some locations, usually along ridges, where it appears that occasional tiles have a reverse pitch, which would allow water to penetrate at cracks in the bedding mortar under the ridge tiles. At best this could be an optical illusion easily determined with a level.

Other Roofing Types. Other roof surfaces, usually small areas, are protected with red "paving" tiles set flat. Examples are the corners of the Observation Tower of the Main House, the pitched

surfaces between the crenallations of the Music Room Tower, and roof surfaces behind this tower and adjacent to the organ rooms.

These roof surfaces generally appear to be in good condition. No broken or missing tiles were observed and mortar also appears to be sound. Because hairline cracks in mortar joints allow water penetration, close inspection of difficult to access surfaces is needed.

Roofing Decorative Details. At several locations are round vertical tiles at ridge lines which appear to be plumbing vents: Main House, west roof section; Annex, one at the west end above the second floor bath and one at the east end of the upper main roof. All are at the ridges. One of particular interest is at the south end of the ridge of the organ room roof. This has a decorative cap. Whether the other vents had decorative caps is not evident at this point -- historic photographs should yield the answer.

Safety Considerations. There are many locations around the buildings, especially at entryways and porches, where people frequently pass under or along roof edges. If any tile failures occur, especially at roof edges, there is the possibility of tile or mortar sliding off and injuring someone. Spot inspections were conducted during the initial investigative period to determine whether there would appear to be immediate concerns. Tile at the locations inspected was soundly anchored and it was concluded that there is probably no immediate safety problem.

Although some tiles have lost their bond to the mortar setting bed, the wire/nail anchors are sound. The uneven projection of the individual tiles as observed along any eave line is not due to misplacement or slipping of tiles. It was intended to have an uneven projection of the roofing tiles at the eaves to create a textural effect within the context of the other textures of the building. Therefore, this uneven projection cannot be utilized as a visual method of inspection for soundness of tiles. The tile needs to be inspected regularly, and will need to be done by close, thorough inspection (see recommendations).

Chimneys

Tile was utilized in several different ways in the chimney designs. There are five chimneys in all, and each is a unique design. At the east section of the Main House, the chimney for the kitchen and Mrs. Johnson's Sitting Room is stuccoed with red tile half-rounds (like roofing tile) incorporated for grills. At the west end of the Living Hall, the chimney for the fireplace has stuccoed walls and the red tile grills are done with flats, utilizing what are probably "paving" tiles. The top of the chimney is a low pitched gable and finished with red "pavers", set flat. The chimney at the west end of the building, which is for the fireplaces in the Lower Music Room and the Spanish Sitting Room, has a pointed arch cap protected with small red square tiles. The ends of the arch are finished with small square decorative tiles. The top of the chimney proper is protected with red flats like "pavers" bordering squares set flat in the wall surface and corner to corner, like a band of diamonds.

The chimney at the west end of the Annex has three horizontal bands using red "paver" flats. The chimney of the south side of the Music Room has a cap of two intersecting pointed arches, also protected with small square red tiles and small square decorative tiles on the arch ends (similar to the chimney at the west end of the Main House). There are red tile flats at the base of the arches and below on the faces of the chimney are red tiles set flat into the wall faces creating a series of kite shapes.

As observed through binoculars, the tile and the mortar joints of all this chimney tile appears to be in sound condition. Contrary evidence, however, is the red staining on the chimney stucco which indicates that the tile is deteriorating. Close inspection should thus be conducted, again at such time as protection of the roofing tile is available.

Exterior Decorative Tile

This categorization is defined as glazed tiles with various patterns and colors. Already discussed above are decorative glazed tiles on the two pointed arched chimney caps. These have a red clay body.

The Observation Tower of the Main House has a band of decorative tile of a white clay. Except for the tiles at the turning of each angle, the pattern is pressed into the tile face (similar to encaustic tile). The color glazes fill the depressions and the entire tile face is finished with clear glaze.

There do not appear to be any loose, cracked or broken tiles, and the joint mortar appears tight and sound. Because this tower was designed in part as a bird cote, it is in fairly active use (not necessarily permanent, but at least day use) and various surfaces are subjected to the deposits of the occupants. It does not appear that this has as yet been harmful to the tile or stucco, but should be monitored. Screens could be inserted into the tile ports to keep birds and insects out of the interior of the tower. The glaze of the tile is crazed but this should not be cause for alarm. The crazing is quite likely to have occurred in the kiln firing, rather than having occurred since the tile was set in its final place.

The weather surfaces of the Annex Music Room south window hoods are also decorative glazed tile. These tiles and the mortar joints appear to be in good condition, but need a close, direct inspection to determine whether there are hairline mortar cracks which allow water penetration.

Similarly, the glazed tile of the sun dial on the south wall of the Music Room appears to be in very good condition. The border tiles exhibit crawling of the glaze. This occurred during the firing, i.e., it is an original production flaw and probably has not caused any deterioration, and is not likely to be a future problem. Mortar joints are generally good but do exhibit some chips and hairline cracks. Again, a close inspection needs to be conducted to assess the soundness of the tiles and mortar.

Paving and Coping Tile

Pavings and copings are both included in this group as they are the same type of tile. These are a red clay body produced and fired to provide a reasonable degree of weather and abrasion resistance. More documentary research is needed, but there are some references which indicate this tilework was weatherproofed when originally installed. [See invoices from The Spanish Pottery for July 12, 1927 and May 24, 1931, and a Note dated June 21, 1931.] Although some sealers have been used in recent years, there does not appear to be negative chemical reactions between original and recent products.

Other than specific exceptions, which are described below, the paving and coping tilework is in fair to good condition. The areas under discussion here are the Patio and Annex alcove, porches, the bridge, stairs and areaways, the Annex balcony and Lanai decks, wall and bridge rail caps,

and the deck surfaces behind the organ rooms and flag tower. The majority of the tile is sound, firmly set, exhibits very little deterioration, and the mortar joints are good. There are, however, exceptions and other problems whose solutions will impact some of these tiled surfaces.

Most patio tile is in good condition although some are cracked and chipped. The chipping is probably either from impact damage or weather stresses. There is efflorescence in the area near the entrance to the Main House. Mortar joints have numerous hairline cracks, usually across the joints. All paving tile should be continually inspected and monitored so that failures such as tiles or mortar that fails and becomes loose can be repaired immediately. Eventually the joint grout should be replaced, and this should be done before the setting mortar deteriorates and tiles become loose.

In the Patio are planter boxes along the north wall of the Main House and along the south wall of the Annex. These planter boxes are, as far as is known, concrete and the top of the containing walls are slightly higher than the surface of the patio tile. The tile caps of the planter boxes are consequently only a few inches higher than the patio. The dirt level within the planter boxes has accumulated to a level which subjects the cap tiles to more water which may also be carrying salts from the soil and in turn causing some disintegration of the tile. (See also the Drainage chapter of this report.)

At the right angle joint of the planter edging caps and the patio surface is a mortar closure/trim joint. It was tooled in the form of a quarter-round. Much of this mortar is either broken or missing and needs to be renewed. The soil level of the planter boxes should be lowered below the cap tiles, and eventually some of the cap tiles will need to be replaced.

At the intersection of the Patio and the floor of the Annex alcove, or enclosed patio, is a failure that needs to be corrected. The floor of the alcove is approximately three to four inches higher than the patio. The transition was made with a ramp of about two feet in width and in the line of the south wall of the Annex. It is not known if there is an expansion joint between the patio slab and that of the alcove slab construction. There is no expansion joint in the tilework. Whether because of thermal expansion or differential horizontal structural or seismic movement between the patio and the Annex, or both, three rows of paving tile have been forced upward along most of the length of this junction between the patio and the alcove. The tile has been raised 1/2-inch to 3/4-inch above its bed at the top of the small ramp, which can easily be seen at the drain grate in the southwest corner of the alcove. Photos taken during the years 1979-82 show that this condition existed at that time [Voyta, Creech, "Condition Study", 1979-82]. This condition also prevents proper complete drainage of the alcove floor. These three rows of tile and perhaps an adjacent row on each side need to be taken up and reset. When taken up an evaluation of the substrate will be required and determination made as to whether expansion joints need to be installed in the slab(s) or tiling, or both.

Along the outer edges of at least the south and west porches, the tile paving extends an inch or more beyond the face of the supporting concrete slabs. This is probably an unfinished detail of the work, the vertical tile facing on the concrete not having been installed. The tile mortar setting bed here is susceptible to moisture entry, which can wick in under the tile. This joint should be repointed to provide greater resistance to moisture. Also grade should be maintained at least two to three inches below the joint, such as at the west porch.

Wall and parapet coping tiling is in fairly good condition but does need attention and consistent inspection and maintenance to prevent intrusion of water into the walls. The joint mortar of bridge and Annex balcony parapet copings typically contains hairline cracks. Deterioration of

the joint mortar is more severe in the bridge copings where there is broken and missing mortar, and some tile separation. These conditions allow considerable moisture intrusion into the bridge stucco work and into the structural system itself.

This is also true at the bridge deck. The deck tile to base tile joints at pilasters have separated, grout is missing, broken and cracked. The exact cause of the vertical separation at the deck to base joint has not yet been determined. There is also separation of the tile and stucco. These conditions also need to be corrected to eliminate penetration of water into the structure.

On the Annex south wall parapet, which is the "rail" along the balcony, is a location that does not have a coping tile. This is the location of a smoke vent and may never have been completed. Treatment is needed here to prevent intrusion of water into the wall and under the adjacent coping tiles. Routine inspection, and repair when required, is needed to maintain the security of all coping tile to protect walls and to prevent any safety hazard.

The second floor balconies and Lanai decks of the Annex are of particular concern. The tilework is in as good a condition as any other area but there is evidence that these areas do not drain properly and probably a major cause of the stucco failure on this building. See the Annex Second Floor Patio and Fountains chapters of this report.

The Lanai deck drains to the northwest corner. Historic documents indicate that at one point during the construction there was the intention that this deck drain be piped downward to connect with the system below in the alcove floor, hence to the patio drains. This routing was not constructed. Instead the Lanai drains by a pipe through the space between the first floor ceiling slab and the second level floor framing to the north side of the building. This drain exits the north building wall with a projecting spout. The drain may have leaks; the drain invert is above the deck surface, causing ponding on the deck; tile mortar cracks and separations allow water intrusion into the deck, which probably has no moisture barrier. These factors are probably the cause of much of the failure of the stucco on the alcove ceiling and on the north wall of the Annex. The tiled fountain on the Lanai has also been kept inoperable because of leakage, which would also contribute to the stucco failure on the alcove ceiling.

Poor drainage of the balcony decks also is likely to be contributing significantly to stucco failure throughout the first floor areas of the Annex. A survey of the deck areas shows inadequate and reverse pitch conditions. There are only three drain scuppers through the balcony parapets. Water is probably penetrating the walls along the parapets and along the second floor walls at the wall to deck junctures. There is no evidence of any moisture barrier under the tile decking. Tile grout has hairline cracks (usually across the joint). Grout is missing in some places. A few of the deck tiles are cracked (tiles are 11 1/2" x 11 1/2"). On the deck at the west end of the Annex, approximately 15 tiles are badly pitted and eroded in the area adjacent to the fireplace chimney wall.

In order to eliminate the moisture effects on the stucco work and on the building structure, it may be necessary to take up the tilework on the balconies and Lanai and replace or install a moisture barrier system and repitch the deck surfaces to achieve proper drainage. Although it would seem unfortunate to disturb tilework in reasonably good condition, it is most important to eliminate the moisture intrusion into the building. See the Annex Second Floor Patio chapter of this report for recommended treatments.

Other Preservation Concerns

Consolidants and Sealers. The use of sealers on exterior tile paving to reduce water intrusion (Thompson's Water Seal has been used in recent years as previously noted) has not been demonstrated to be harmful to the tile. Historically a sealer was used when the tile was installed. There may be more appropriate types of sealers formulated specifically for tile. The Tile Council of America may be able to provide some guidelines. Sealers should not be relied upon, however, to prevent water intrusion through cracks in mortar or tile.

The use of a consolidant or sealer on deteriorating tile may be useful to retard deterioration and reduce staining of stucco, such as the deteriorating tile on chimneys and the Chimes Tower. The type of consolidant or sealer needs to be carefully chosen or formulated to prevent entrapment of moisture which could cause more serious problems, such as has been found with stone. If there is any evidence of such problems, consolidant or sealer use is not recommended. If safe to use, it should be considered an interim measure, not a permanent solution. Such deteriorated tile will need to be replaced.

Pesticide Use. Tile is usually resistant to chemicals, especially glazed tile, but pesticide or other chemicals can penetrate and be deposited in cracks in the mortar or tile. It would seem possible that such chemicals could affect at least the cement grouts and substrates. Assistance on this subject is suggested as recommended in the Wood chapter of this report. Pending advice by experts on this chemical concern, continuation of the current policy of not using pesticides is recommended.

Interior Tile

During the period of 1979-82, an extensive documentation of the conditions of the buildings was conducted. [Voyta, George and Creech, Don, "Scotty's Castle Historic Structures Condition Study", DEVA, 1979-82. The study included all structures at Scotty's Castle and the Grapevine Ranch.] The purpose of the study was to document conditions to provide a baseline for monitoring and annual inspections. That study was immensely useful for this current condition survey. More importantly, it should be utilized as originally intended as the comparative baseline for routine annual inspections.

The study recorded the conditions of all materials and surfaces. Deficiencies were categorized as: (A). Missing items, materials, etc., (B). Normal deterioration, damage and wear, and (C). Preventable, visible damage or improper maintenance. Photo documentation was incorporated, showing representative examples of typical conditions and isolated specific conditions. For assessment of present tile conditions, the 1979-82 study was utilized directly to compare conditions recorded and note changes or new situations, which are described below. For the most part, the deficiency conditions have remained relatively stable.

Types of Deficiencies, Interior Tilework Categorized from the 1979-82 Condition Study (With explanatory notes).

Tile

- Broken tile
- Missing tile (and grout)
- Cracked tile

Loose tile(s)

Chipped tile (edges or in field; usually from impact damage in heavily used areas)

Pitted tile (usually in heavily used areas)

Tile scratched or gouged (usually from a dragging door or furniture)

Tile separation (gap at a joint)

Tile/plaster separation (or separation at a joint with other materials)

Tile glaze flaking or crazing (Annex second floor bath)

Joint Mortar (Grout)

Missing grout: between base tile and floor tile; between base tiles; between floor tiles

Grout loose

Hairline cracks across grout

Crack along grout joint (at edge of tiles)

Grout chipped

Mortar eroded (primarily pertains to fountains, sink or bath areas)

Improper mortar (from repairs)

Use or Maintenance Causes

Normal wear

Waxed-in dirt (floor and/or base tile, usually at room perimeters)

Discoloration (from traffic, waxed-in dirt, water stains, smoke stains, etc.)

Water stains (from minerals in water)

Oil stains

Patched and/or stained tile and/or grout from improper repair (Main Hall stair riser)

Holes from anchors or fasteners

Plaster spill on base tile

The following describes changes in conditions or observations by comparison to the 1979-82 survey, or new conditions noted:

Main House

Solarium: Although the fountain tile seems soundly bonded, mortar is eroded and cracked, and some mortar is missing.

Solarium/Lower Music Room Doorway: Insect hole in floor/base tile joint, south jamb. Appeared ca. March 1989.

Scotty's Room: Floor tile scratched from dragging of exterior door.

Southeast Alcove of Great Hall: Hollowness under floor tile in this area.

Southwest Alcove of Great Hall: Hollowness under floor tile, particularly along line of arch.

Great Hall Stairway: Broken base tiles (at stringer line), east wall, and grout missing.

Dining Room: The previously recorded cracked tiles at the kitchen doorway do not appear to show any change. They are sound and cracks have not opened.

Upper Great Hall (Balcony): At the exterior door to the bridge, cracked tiles were previously recorded here. There is no apparent change in the cracks, however, some of the joint grout is loose now because of the heavy foot traffic. This grouting should be renewed.

Bath off Johnson Suite: Broken floor tiles to right of radiator, north wall.

Johnson's Bedroom Closet: Previously recorded separation of wall plaster and base tile at the south wall appears to have been repaired.

Spanish Bedroom Bath: In the tub enclosure there is some cracking and chipping of joint grout and there is a hole in a joint. There is separation at the tile to tub joint, but it is not extreme.

Spanish Sitting Room: There are some cracks in floor tile grout not previously recorded. It appears, however, that missing grout at the red tile of the fireplace firebox has been repaired.

Annex

Bokhara Room: Previously recorded chipped floor tile grout at the doorway is now broken.

Most deficiencies in interior tilework are relatively minor. A high percentage can be remedied by renewing the joint grout. The few loose tiles that exist should be reset.

Examples where no action except continued monitoring is recommended are the cracked floor tiles at the Dining Room/Kitchen doorway and those across the archway of the Great Hall's southwest alcove. There is no reason to replace these tiles as long as they remain stable and soundly set. Maintaining the soundness of the joint grout is the key to preserving the tiles.

Where tiles are broken or missing, these can be replaced from the collection stock provided they exist and there are enough to maintain the established minimum number in the collection. The collections policy established is to maintain a minimum of five samples of the same item.⁷⁵

Any attempt to patch chips, pits or gouges in tile is not recommended. It can be done but is rarely successful. Glaze failures, such as glaze to clay body bond failures or crazing, are not repairable.

Tile can be reproduced but not without difficulty. To achieve this the first hurdle will be to find a company willing to undertake the effort. It will require testing and experimentation to achieve the correct results in clay and glazes, requiring a great deal of time. Glaze compositions are difficult to duplicate and firing results vary, but reasonable duplications should be achievable. It will be costly, especially for small numbers of tiles of any one design.

Maintenance of grouting is important in order to reduce intrusion of water into the tile system and into substrate and structural materials, especially in exterior tilework. Even in interior tilework, broken and missing grout conditions are water entry sources when floors are mopped, particularly at base to floor joints. Examples are kitchen floors, kitchen sink counters, the Music Room stage, and in baths, especially at gaps between the tile and tubs or other materials. Renewing and maintaining good grouting also preserves the tile and its setting mortar and bond.

Sand for setting and grouting most likely came from the same source as that for stuccoing so is available on site. Therefore the preservation maintenance crew has the materials and the expertise to accomplish most of the repair work needed. On a relative scale, however, interior tile repair is not nearly as critical as many other needs and would logically receive a lower priority.

A number of alternatives for protection of flooring tile from wear have either previously been utilized or considered -- runners, reproduction rugs, having visitors wear booties, sealers and waxing. Runners, such as those currently used on the carpets, are a valid option, and they also help to control visitor traffic. They tend to be visually intrusive, however, the degree depending

75. From HSR review meeting, November 13-16, 1989, as recommended by Western Regional Curator and Scotty's Castle Curator.

on the color, and are not the best option. A more preferred option would be reproductions of the area rugs which were used historically. (See the Historic Furnishings Report).

Having the visitors wear booties, as has been done in the past, is a good option. There are drawbacks, however, including the inconvenience for the visitors and the time and costs involved by the staff and for cleaning. The currently used booties do not stay on well and could be a safety hazard for visitors. A type that can be tied securely would be recommended.

Sealers are not recommended, but waxing the tile floors, which was done historically is recommended to provide a sacrificial protective coating.

In terms of cleaning of tile, abrasive cleaners were apparently used historically but are not recommended for preservation maintenance. Use non-abrasive cleaners, such as biodegradable detergents available from Amway or Shaklee, which are gentle but effective.

Washing and re-waxing tile floors is recommended. Wash by hand (not with a mop) using only enough water/cleanser to remove old wax and dirt build-up but to minimize moisture intrusion into cracks in the joint grout or tiles. Allow to dry thoroughly before waxing. Re-wax with a liquid wax recommended by the tile industry. (This author suggests the possibility that the wax that may have been used historically could have been Johnson's (Wax Co.) "Glo-Coat"). Clean and wax periodically, the time interval determined by the wear patterns. Wall tile don't need waxing or nearly as much cleaning as floors.

RECOMMENDATIONS

Roofing Tile

1. Obtain equipment for protection of the roofing tile so that inspections and replacement and repair work can be accomplished. Do not walk on roofs without protection for the tile. An attempt has been made by the park staff to obtain mats which can be rolled out on the roof to provide cushioning. This method is apparently used at the Hearst Castle and is a workable method. The acquisition of matting or other workable protection is recommended.
2. Locate a source of replacement tile. Either salvaged tile or the production of new tile would be suitable. See the Bibliography for possible sources of used or reproduction tile.
3. To the extent possible, only broken, cracked and missing roofing tile should be replaced. This will depend on how well the tiling system will allow for access to individual tiles, the difficulty of removal and replacement of bedding mortar, and whether bedding mortar itself contributes to water intrusion. The color of replacement tile will also have to be watched carefully so that it will blend in with surrounding tiles.
4. Inspection of all roofing tile should be conducted at least annually. Tile at the eaves should be carefully inspected, especially at entryways and along eave lines where frequent pedestrian traffic occurs.

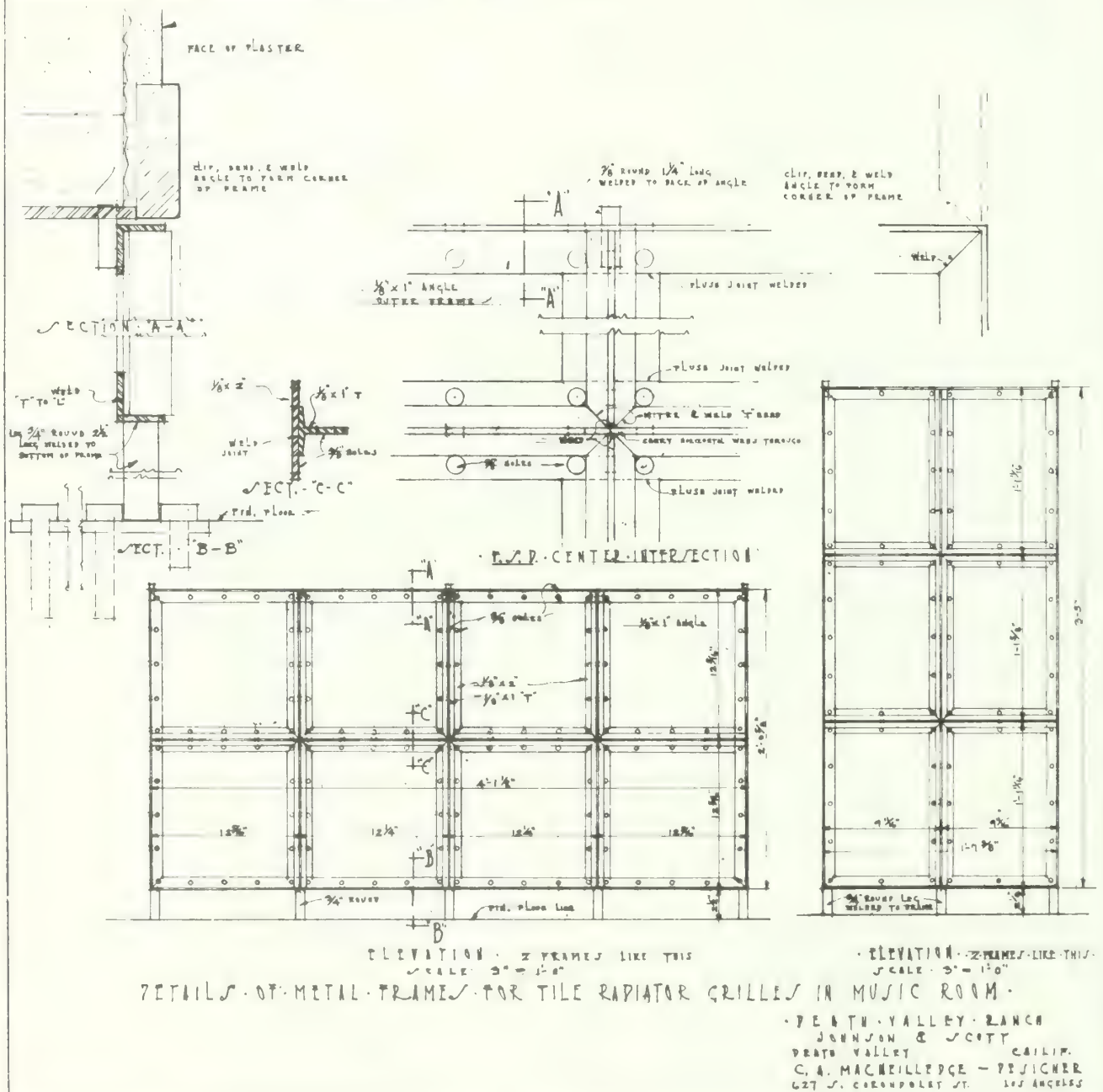
Exterior Paving and Coping Tile

1. Regrout Patio tile as required to prevent grout loss, loose tile, and deterioration of setting mortar and substrate materials.
2. Clean and repair the drains in the Patio planter boxes as required; repair concrete where required and renew or add waterproofing; reduce the soil level in the planter boxes; regrout planter box edging tile; renew the grout trim between the patio tile and planter box edging tile; replace deteriorated planter box edging tiles when necessary and available.
3. At the Patio/Annex alcove intersection, take up the paving tile as necessary, determine the requirements for expansion joints and install as required, reset the drain body as required, and reset and regrout the tile paving.
4. Point the joint at the underside of projecting tile on porches and steps where the concrete wall or riser was not tiled to reduce water penetration into the tile setting bed. At porches, maintain grade a minimum of 2 inches below this joint.
5. Renew and maintain joint grouting of wall and parapet copings, making sure tiles are firmly set. Regrout bridge tilework. Install mortar cap protection at vent location in parapet on south balcony of Annex.
6. In conjunction with Annex stucco and Lanai fountain repair projects, reset the tile of the Lanai and balcony decks to provide positive drainage away from walls and parapets and to drains.
7. It is noted that all tile joint grouting renewal and sound tile system maintenance is also prevention of safety hazards which would otherwise exist with broken and missing grout and loose tiles.

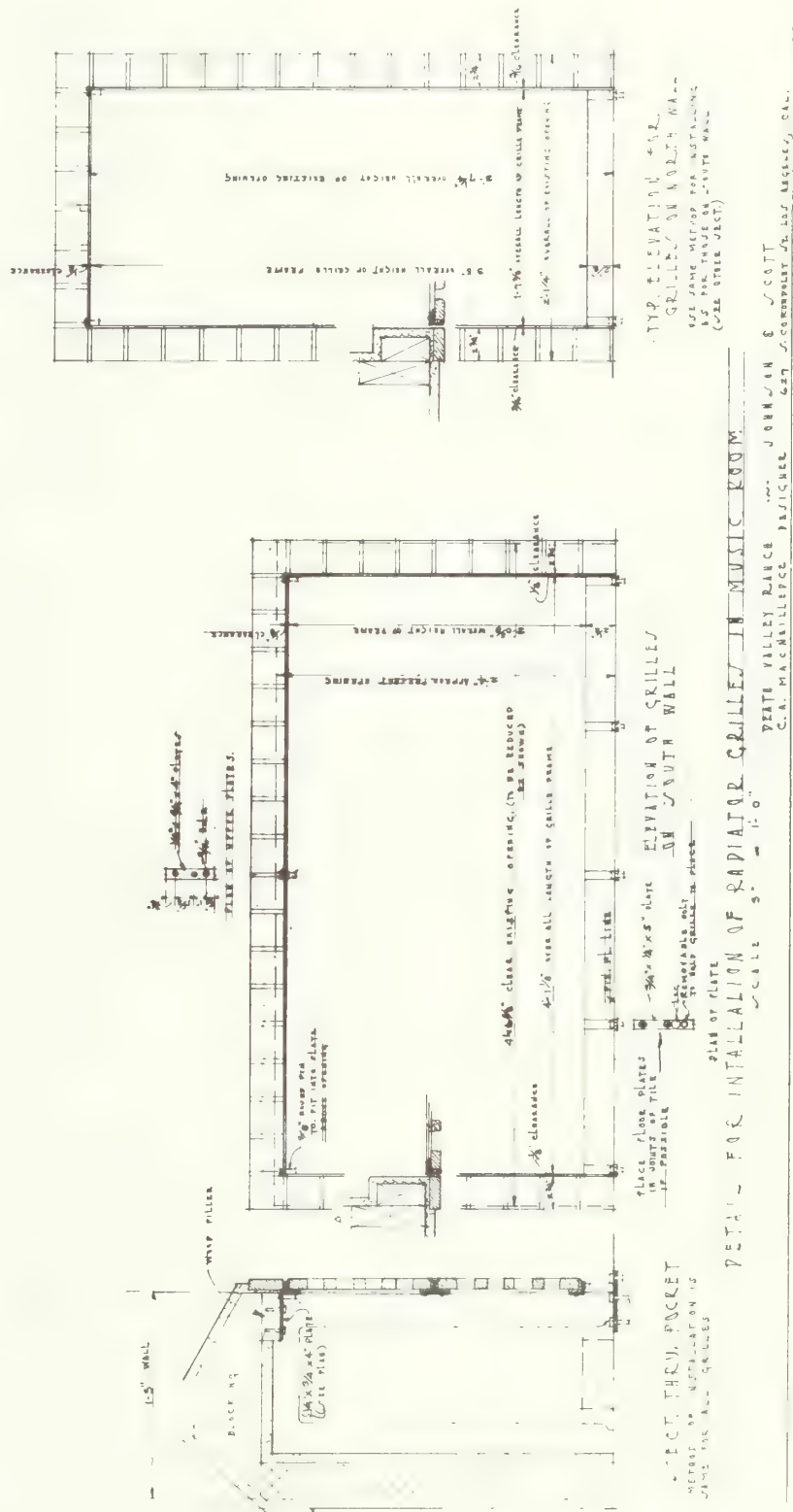
Interior Tile

1. Regrout floor tile, reset loose tile as necessary, in heavy foot traffic locations before deficiencies cause tile breakage or a safety hazard. The location that should be repaired in the near future is on the balcony of the Great Hall near the doorway to the bridge.
2. Replace deteriorated, broken and missing grouting. This can be done by the preservation maintenance crew and could be planned over a period of years, doing a room or group of rooms during the low visitation periods. Replace broken or missing tiles using existing stock when available provided that such stock is greater than the established minimum samples to be maintained in the collection.
3. Replacement of cracked, chipped or pitted tiles is not recommended unless they become so damaged as to create a safety hazard or cause deterioration of adjacent tilework. Patching of chipped or pitted tile is not recommended.

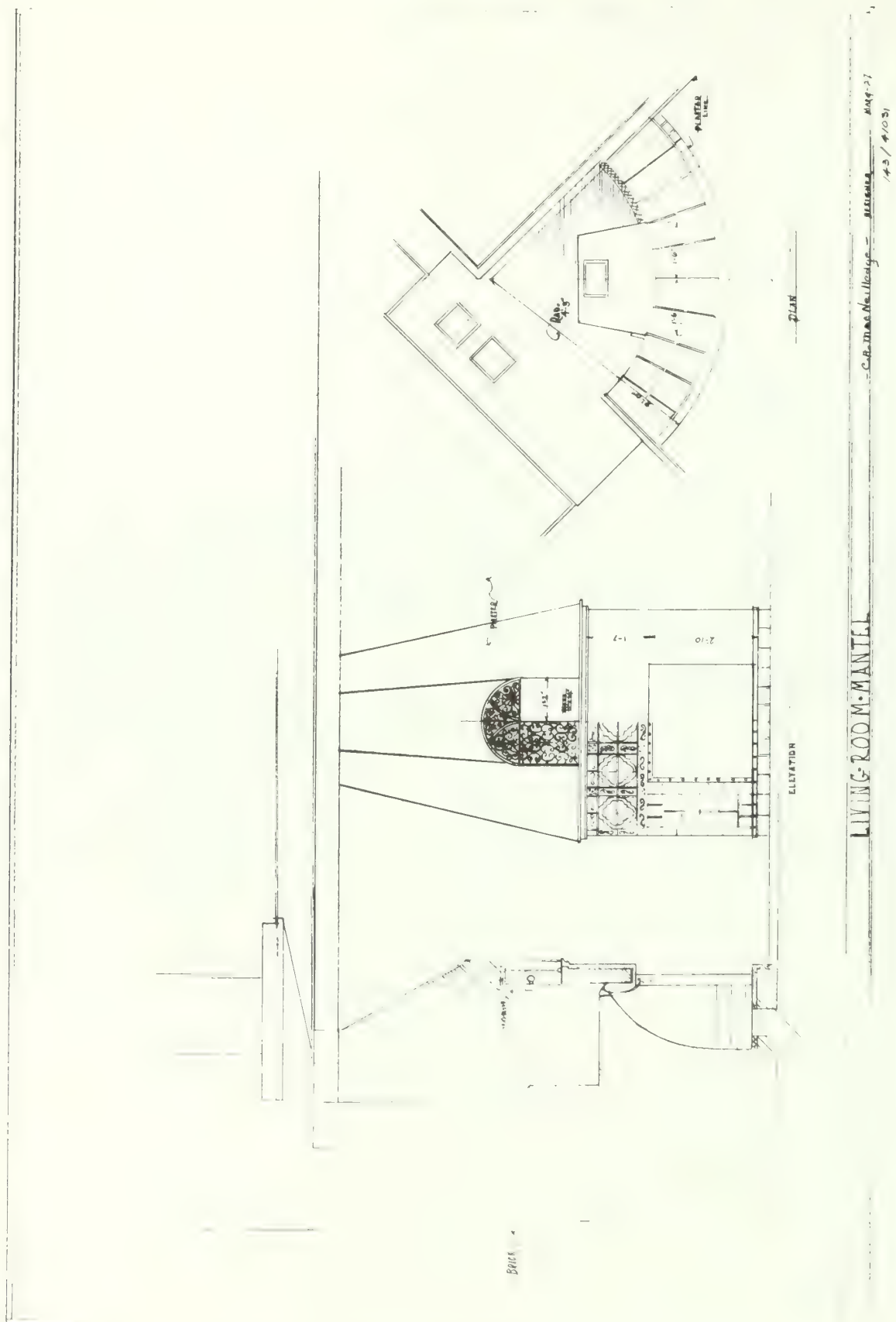




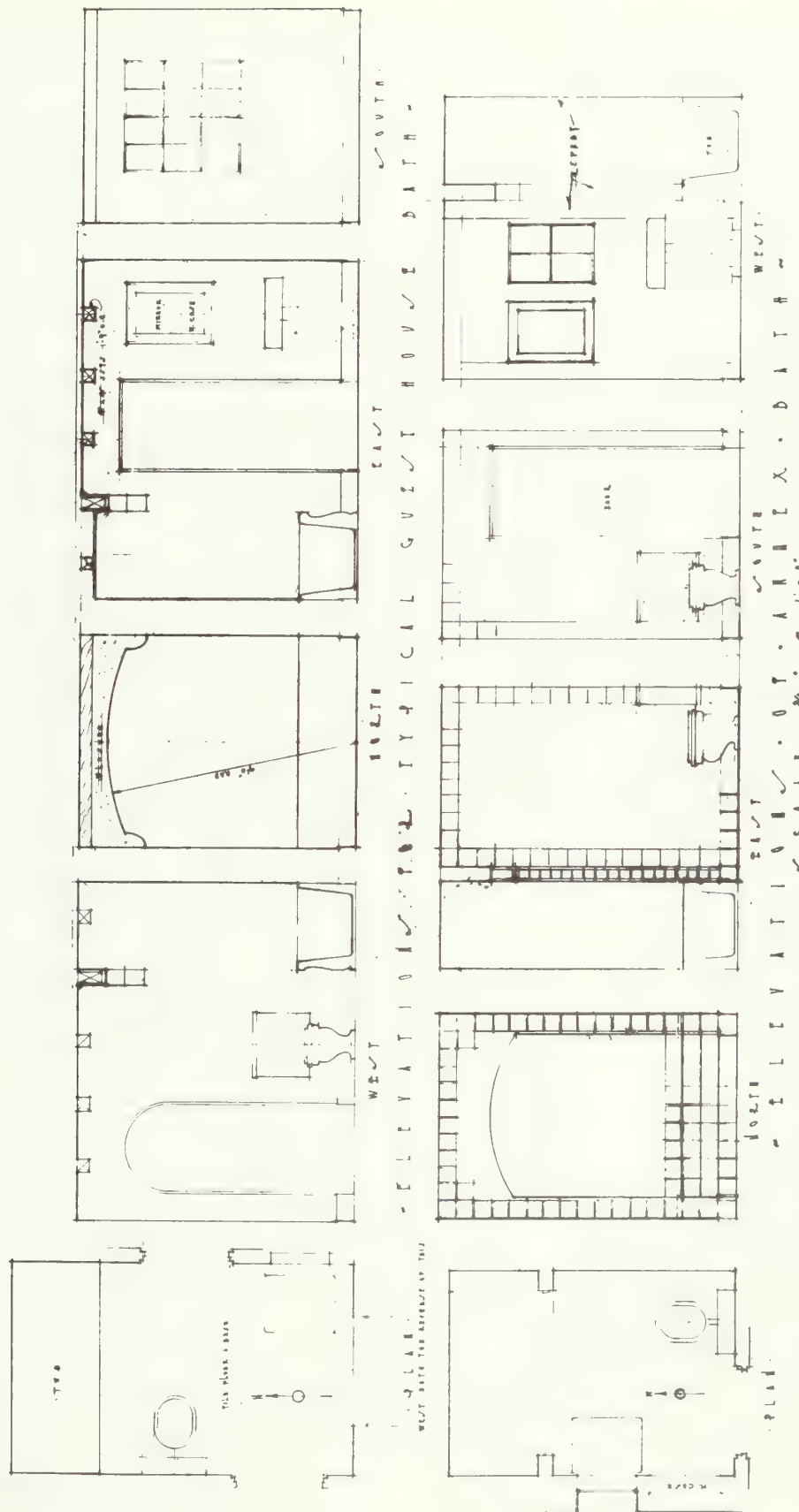
Historic Drawing 2: Metal Frames for Tile Radiator Grilles in Music Room, Details



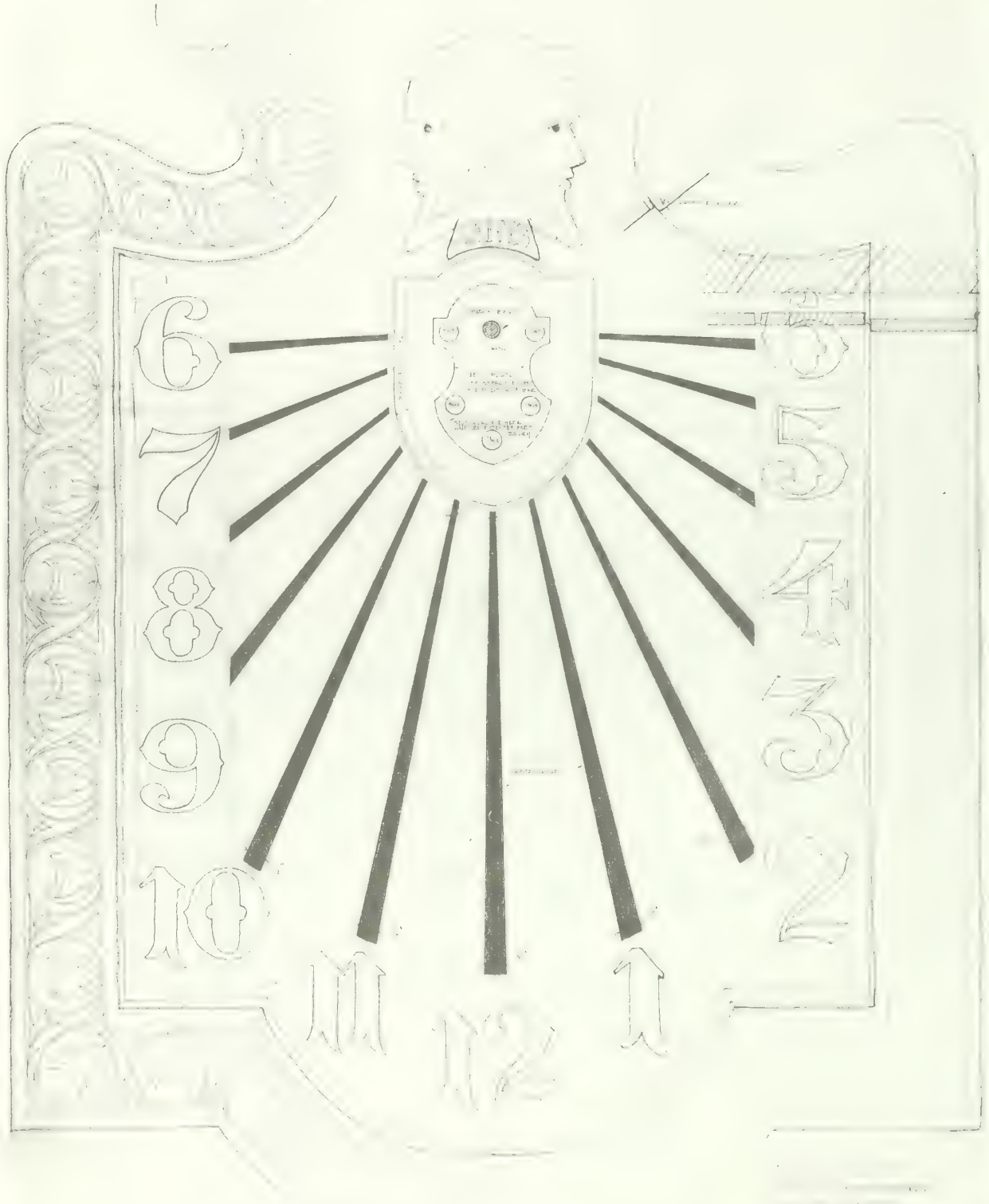
Historic Drawing 3: Installation of Radiator Grilles in Music Room, Details



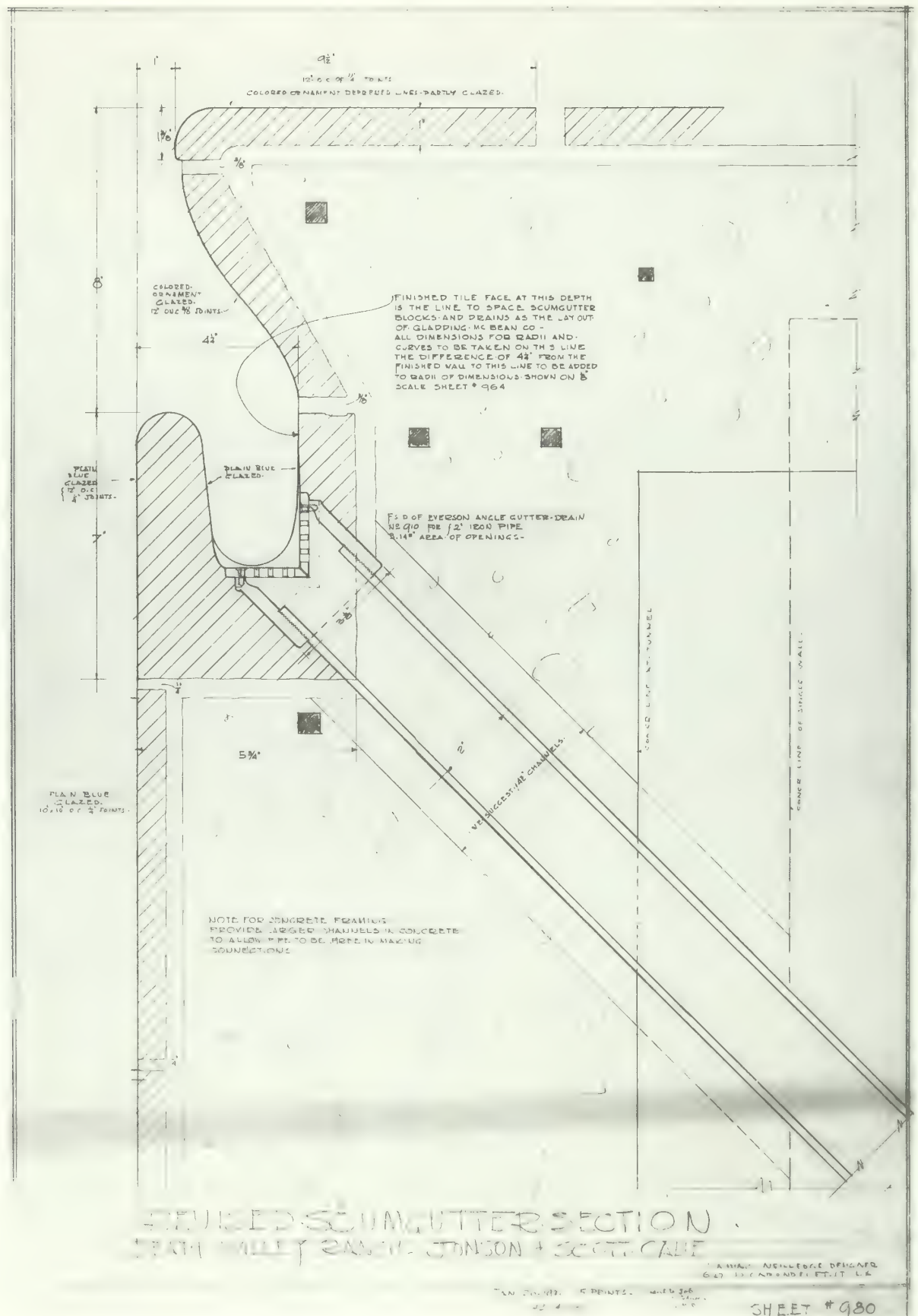
Historic Drawing 4: Living Room Mantel (Lower Music Room) Details



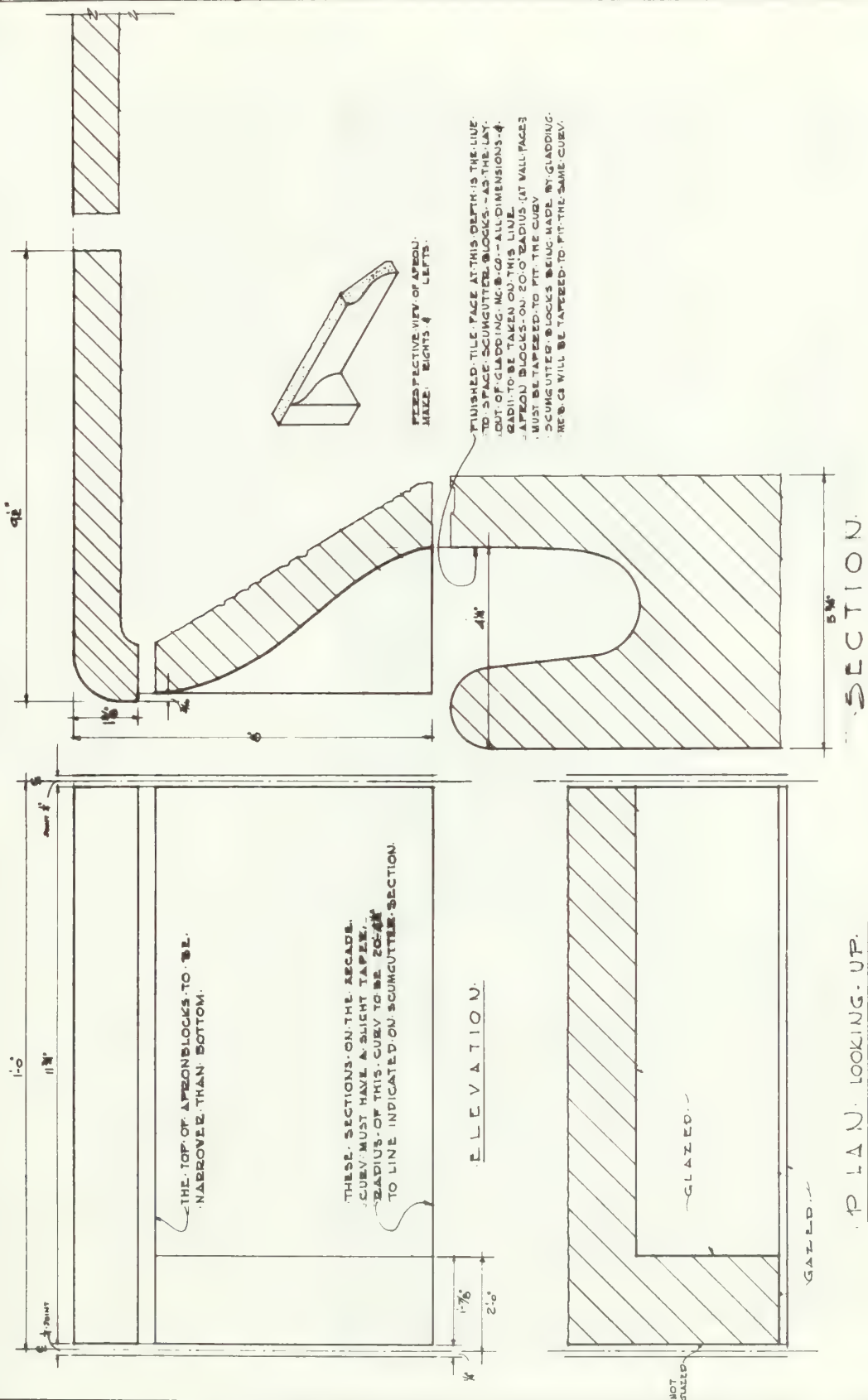
Historic Drawing 5: Room Plans and Elevations including Annex Bath



Historic Drawing 6: Sun Dial on South Wall of Annex



Historic Drawing 8: Revised Scumgutter Section



END BLOCK F.S.D. OF SCUMCUTTER APRON--DEATH VALLEY RANCH--JOHNSON & SCOTT-CALIF.

224 MAC MILLIDGE DRIVE
BENT, SO. CALIF. ST. L.A.

MS/H030

SHEET #982

Historic Drawing 9: Pool Details



Historic Drawing 10: Ornamental Border to Swimming Pool



Photo 1: Main House roof details, view from west. Shows the observation tower and the variety of chimney designs. Note the tile attic vents. R.L. Carper, April 1989.



Photo 2: East portion of Main House roof and observation tower. View from northeast shows tiling detail at roof rake edge. Photo by R.L. Carper, April 1989.



Photo 3: View of Annex from southwest. Photo by R.L. Carper, April 1989.

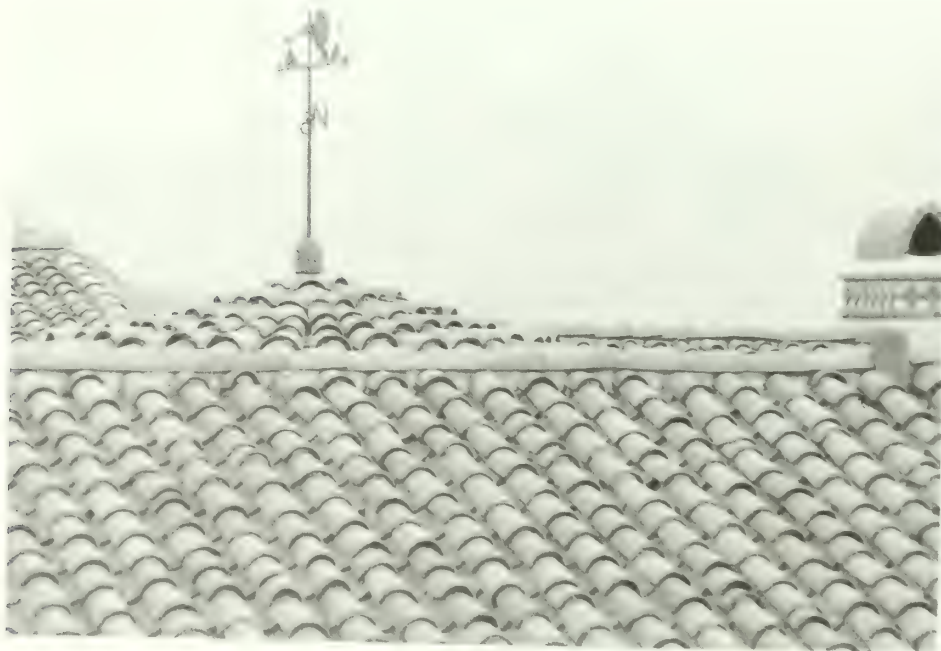


Photo 4: Roof surfaces detail, north side of Annex. Note tiles beneath ridge with possible reverse pitch; also tile plumbing vent at right. Photo by R.L. Carper, April 1989.

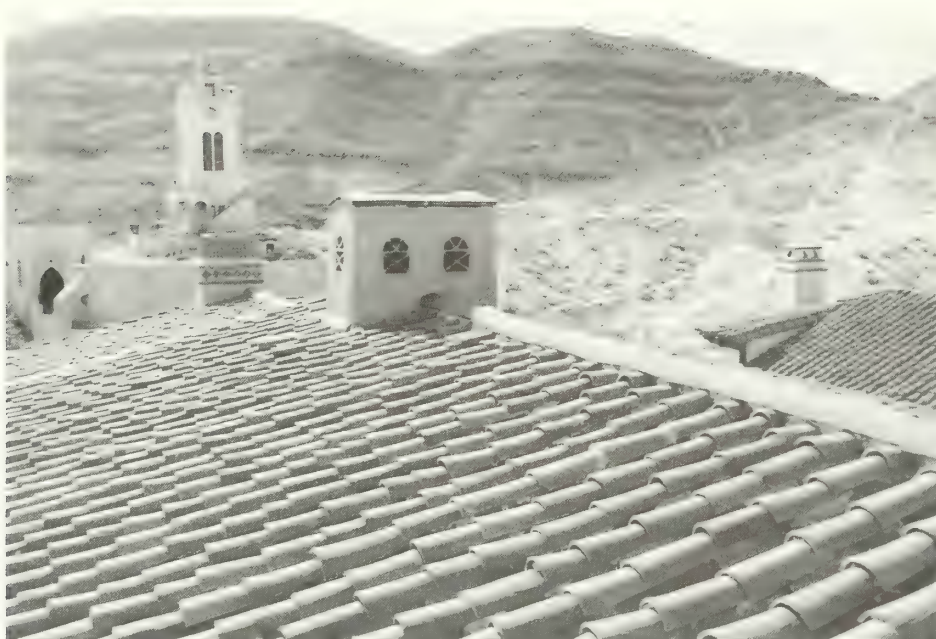


Photo 5: Main House roof, looking west from observation tower. This view shows the purposeful lack of horizontal course alignment. Again note tiles immediately below the ridge. Photo by R.L. Carper, April 1989.

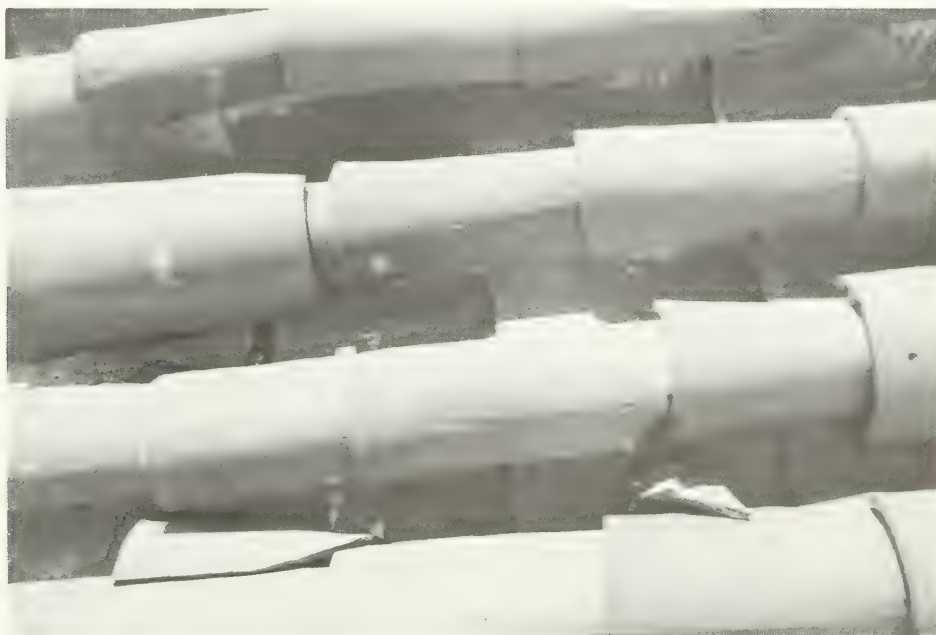


Photo 6: Roof tile detail, Main House at west side of observation tower. Shows broken tile, exposed bedding mortar and temporary modern tile. Photo by R.L. Carper, April 1989.



Photo 7: Portion of central roof, Main House, south side (foreground). The detail below is at the location indicated. Photo by R.L. Carper, April 1989.



Photo 8: Roof tile detail, Main House. Portion of central ridge indicated above, showing cracked mortar and broken tile. Photo by R.L. Carper, April 1989.



Photo 9: Main House roof, detail at base of east chimney, south side. Note mortar under ridge tiles, beneath chimney flashing and excess bedding mortar at individual tiles. Photo by R.L. Carper, April 1989.



Photo 10: Roof tile detail, Main House, section of east ridge. Shows exposed bedding mortar and possible reverse-pitched tiles. Photo by R.L. Carper, April 1989.



Photo 11: Solarium roof. Note missing tile on ridge adjacent to wall of Main House. Photo by R.L. Carper, April 1989.



Photo 12: Dining Room bay, Main House. Shows missing and broken ridge tiles. Photo by R.L. Carper, April 1989.



Photo 13: Annex roof detail at east end. A highly textured appearance resulted from the variations of tile curvature and overlap. Photo by R.L. Carper, April 1989.



Photo 14: Vent cap, roof of organ chambers. Photo by R.L. Carper, April 1989.



Photo 15: Main House, detail of roof edges, north elevation. The uneven projection of tiles at the eaves was intended and is not an indicator of loose tiles. Photo by R.L. Carper, April 1989.



Photo 16: East chimney, Main House. One of several different designs using tile for grills. Photo by R.L. Carper, April 1989.



Photo 17: Annex Flag Tower, or Music Room Tower. Photo by R.L. Carper, April 1989.



Photo 18: Annex, south wall of Upper Music Room. Shows tiled window hoods and sun dial. Photo by R.L. Carper, April 1989.



Photo 19: Decorative tile detail on weather surfaces of window hood. Photo by R.L. Carper, April 1989.



Photo 20: Annex; the chimney and sun dial at south wall of Upper Music Room. Illustrates the variety of types and uses of tile. Photo by R.L. Carper, April 1989.



Photo 21: Sun dial on south wall of Upper Music Room of Annex. This decorative glazed tile is in good condition. The key to the stability and preservation of this tilework is to maintain the joint grout, which appears sound but does exhibit hairline cracking. Photo by R.L. Carper, April 1989.



Photo 22: Main House, observation tower. This decorative tile band is also in good condition, even though it is subjected to extreme temperature variations. Photo by R.L. Carper, April 1989.



Photo 23: Patio between Main House and Annex; view to west. Photo by R.L. Carper, April 1989.



Photo 24: Tile coping in patio at areaway grill adjacent to Main House. The mortar bead at the base of this coping or edging tile is typically cracked, broken or missing. At planter beds, many coping tiles are cracked, chipped or disintegrating and mortar is failing. Some patio tiles are cracked or broken. Photo by R.L. Carper, April 1989.



Photo 25: Patio paving tile. Photo by R.L. Carper, April 1989.



Photo 26: Patio paving tilework. Generally sound, but these details illustrate efflorescence, chipped or broken tiles and grout deterioration. Renewal of the grout will enhance preservation of the system. Photo by R.L. Carper, April 1989.



Photo 27: Main House, south entry steps. This work was never completed and should be preserved in this state. It is important to maintain good grout protection against water intrusion yet retain the unfinished nature. Photo by R.L. Carper, April 1989.



Photo 28: Edge of west porch, Main House. While preserving the unfinished state, the bedding mortar as well as joint grout need to be maintained to prevent water intrusion into the tile system. Photo by R.L. Carper, April 1989.



Photo 29: Second floor bridge detail between Main House and Annex. As well as loss of grout in the base to deck tile joint, there is vertical separation between the deck and wall, also illustrated by the separation between the stucco and half-round tiles. These openings as well as cracks in the stucco contribute to material deterioration of the entire structure by water intrusion. Photo by R.L. Carper, April 1989.



Photo 30: Example of sources of water intrusion. Shows intrusion into material and structural substrates: hairline cracks across tile joint grout; and stucco cracks just above base tile (sometimes occurring as a separation between the tile and stucco). Photo by R.L. Carper, April 1989.



Photo 31: Annex balcony, east end. These deck areas appear to have inadequate slope for good drainage. Some areas drain toward walls, rather than away. There are only four drains for the entire area, including the drain at the corner of the Lanai deck seen in the photo below. This is probably part of the cause of stucco failure in spaces below, including the alcove. Photo by R.L. Carper, April 1989.



Photo 32: Fountain on Annex Lanai. The supply piping and drain need to be repaired or replaced; most fountain tile will probably have to be replaced; the Lanai deck drain system needs to be replaced; and the tile deck re-pitched for good drainage. Photo by R.L. Carper, April 1989.

SECOND FLOOR ANNEX PATIO ASSESSMENT

OBJECTIVE

Portions of the second floor level of the Annex are exterior walkways and patios. Along the south side is a walkway; there are patio areas at both the east and west ends of the building, and a patio at the approximate center. Off the end of the bridge from the Main House is a covered, partially enclosed entryway, to the west of this the walkway has a roof cover. These walkway and patio surfaces are tiled.

The tiled surfaces of these patios and decks leak, and do not drain well or away from walls. Leakage through these decks has caused damage to building fabric below, and is particularly evident in the alcove beneath the central patio. Stucco has become detached, and has fallen from the ceiling of the alcove. Additional detached stucco was removed here as it was a safety hazard.

The fountain in the central patio (Lanai) also contributes to the water damage, particularly because of leakage through deteriorated tile mortar and broken tiles. It is possible that the fountain piping system is also deteriorated.

The deteriorated wooden screened porch structure of the Lanai is discussed in the wood section of this report. Detail concerning the tilework of the Lanai fountain is to be found in the tile section; the fountain plumbing system analysis is to be found in the section on fountains.

This section provides an assessment of treatment alternatives for the tiled walkway and patio decks, the objective being to eliminate leakage and stop damage to the building fabric.

DOCUMENTATION

Many documented leaks exist in the tile walkways that cover certain roof areas in the two buildings. Thompson's water sealer has been applied approximately every year since 1983 to the annex tile walkway/roof.⁷⁶

In November 1982 loose ceiling stucco was removed from the Annex Garage (and possibly the Walk-in Cooler).⁷⁷

The building condition survey conducted between 1979 and 1982 provides a good baseline for the locations and extent of material and system deficiencies.⁷⁸

ANALYSIS AND FINDINGS

The structure of the second level of the Annex is a concrete slab. The tile paving of the patios and walkways is set in a mortar setting bed on the concrete slab. It is not known if any type of

76. From "Notes on the Maintenance of Scotty's Castle, Building SC02, Main House and Annex", James O'Barr, DEVA, February 1990.

77. Ibid.: Conversation, George Voyta & John May, January 1990.

78. Voyta, George and Creech, Don, "Scotty's Castle Historic Structures Condition Study", DEVA, 1979-1982.

waterproofing or membrane was applied to the slab before the tile system was installed. Where the Lanai posts have been removed for repair and restoration, the concrete slab is visible at the bottom of the post seat, so if this is an indicator, there appears not to be a membrane type water/moisture barrier.

Since most of the deck areas have no roof protection, they are directly subjected to rainfall and snowmelt. In addition the Lanai patio has been severely affected by the deteriorated, leaking fountain. With minute cracks in the paving mortar, and especially if there is no moisture barrier on the concrete slab, leakage and moisture seepage through the tile deck and gradually through the concrete slab has gradually increased over the years and will continue until corrected.

The Problems

Along with the lack of a moisture barrier, or at best a deteriorated barrier, another significant deficiency is poor drainage. The walkway along the south side of the Italian Room is level or is pitched toward the parapet wall. Along the walkway at the south side of the Music Room the deck is pitched toward the building wall, rather than away from it. There are no drains along either side of these walkways.

The Lanai patio deck is also pitched toward the building, although intended because there is a drain at the northwest corner. Puddling occurs in the northwest corner area of the deck and the invert of the drain pipe, which is in the tile base trim of the wall, is 1/4-inch to 3/8-inch above the surface of the tile deck. In addition, the lowest surface of the deck is approximately 8 inches away from the wall. The tile grout in this area exhibits water and chemical etching. The drain is routed across the concrete deck beneath the floor framing system of the guest bedrooms and exits the north wall of the building through a scupper. It is possible that this drain pipe leaks. Unfortunately there is no access to the space between the concrete deck and the floor framing above. (There appears to be enough clearance in this space to work if there were access.) The stucco damage of the ceiling and walls of the alcove below, as well as on the north exterior first floor wall of the building, is probably primarily from the water leakage of the Lanai deck and possibly the drain as well.

The patio deck to the west end of the Italian Room drains to two scuppers through the parapet wall, one at each of the outer corners. However, there appears to be a low area around the southwest corner of the chimney at the east side of the deck. The tile surface here is badly eroded and pitted.

The deck area outside the east end of the Music Room appears to drain fairly well to a scupper through the east parapet wall at about its midpoint. (The scupper needs to be re-anchored and properly sealed.)

The lack of positive drainage away from building walls and ponding are major deficiencies, which allow considerable quantities of water to penetrate the structure through even the smallest cracks in tile or mortar. Deck surfaces should have enough pitch to allow water to drain off fairly rapidly.

Although the tilework of these decks is in reasonably good condition, there are hairline cracks across joint mortar, separation of mortar and tile, or some missing joint mortar. These conditions are particularly detrimental at the joint along the base of the walls, and is where they are more

predominantly found. There are a few deck tiles which are cracked, though not many, but these also allow water penetration.

Some walls have a base finish of the "travertine" stucco rather than tile. Hairline cracks in this material also admit water into the walls.

It was reported that Thompson's Waterseal has been applied at least once each year (with a goal of twice per year). Concrete slabs at the rear of the Annex are also treated. [From field notes, 3/1/89, discussions with staff.] This aids in reducing migration of moisture through the tiles but is not effective in preventing water from penetrating cracks or voids where mortar is missing.

The Lanai patio fountain is a major competitor to the weather as a source of water damage to the building. The fountain's plumbing system and its tilework will have to be repaired and restored to eliminate it as a source of water degradation to the building fabric.

ALTERNATIVE TREATMENTS

Alternative 1

Although the deck tile will probably survive reasonably well for (an unknown number of) years if no action were taken, leakage through the deck and supporting components of the structure will continue to adversely affect wall systems, stucco and plaster below. Therefore, to stop stucco and plaster failures, wall system failures, and to prevent other damage to the structure and potentially to furnishings, the no-action alternative is not recommended.

Alternative 2

Take up tile deck and tile wall base trim, seal concrete slab with a waterproof membrane (liquid applied type), repair/replace deck drains, and reinstall tile providing a carefully controlled setting bed to establish positive drainage for all deck areas. Repair/replace Lanai fountain plumbing system. Replace/restore fountain tilework.

A slightly different system considered was the use of a liner type waterproof membrane system on the concrete slab. Although a sheet membrane type would provide good moisture protection, it would have a major effect on the level of juncture of the deck with the perimeter walls. An additional concrete slab would probably be required on top the waterproofing membrane in order to provide stability and solid mortar bonding for the tile. This would raise the level of the finished deck surface three to four inches above the existing level as well as increase the load on the structure. For these reasons this type would not be desirable.

Alternative 3

A partial treatment option would be to modify only those portions of the deck areas required to provide good positive drainage, eliminate low spots and replace damaged or deteriorated tile, and renew joint grout in all remaining tilework.

This alternative would be similar to alternative two, but would accomplish only part of the job, potentially not correcting all deficiencies and is thus not recommended.

RECOMMENDED TREATMENTS

Since the objective is to eliminate the intrusion of water into the structure which has caused stucco, plaster and wall failures, full treatment is recommended, described in alternative two above.

Process outline:

- Take up tile deck and tile wall base trim (all good tile to be reused)
- Clean mortar off tile
- Remove old mortar setting bed from concrete slab
- Install moisture barrier membrane on concrete slab; provide integrated membrane at base of walls; joint seal may be needed for cracks in concrete slab; a bonding agent may be needed for the tile setting bed
- Repair/replace drains (3 scuppers and Lanai drain to north building wall -- requires creating access opening)
- Repair/replace Lanai fountain plumbing system
- Cut wall stucco where necessary for new pitches of tile deck to accommodate tile base
- Install new mortar setting bed at new grades for positive drainage pattern
- Reinstall tile deck and wall base trim tile, replacing broken and eroded or pitted tiles
- Repair/replace "travertine" style wall base where required
- Replace/restore fountain tilework

OBSERVATION TOWER DECK

OBJECTIVE

The objective of this assessment chapter is documentation and analysis of the deck (flooring system) of the observation tower located on the south elevation of the Main House. Treatment of this feature is required to stop intrusion of water into the structure beneath and subsequent fabric deterioration, which adversely affects the integrity of the building structure and interior components within the tower and the significant finishes in the rooms below.

DOCUMENTATION

Comparison of historic construction drawings⁷⁹ to the actual configuration of the tower elements shows that the design was significantly revised during construction. The changes did not radically alter the appearance from the exterior however. The 1927 design intent included a sloped trap door at the head of the stair to provide access to the open tower space. A doorway at the northeast corner of the space was apparently intended for access to the Main House roof, with an outside stair and landing. This was not built and the trap door was also deleted. Instead, a vertical door opening was provided which required some other modifications, including lowering the observation space floor elevation, and raising the roof structure of the stair passage. (This can be seen by comparison of the historic drawing with both commonly published historic construction photographs and contemporary photographs.)

The flooring system was also a significant deviation from the tiled decks and floors used elsewhere throughout the buildings, both inside and out. The wood flooring of this observation tower deck was intended as shown on the 1927 drawing: "Plank floor laid in white lead and pitched 1/4" to the foot to o.s. openings". ["o.s." meant outside].

For a period of time during both the Gospel Foundation and NPS management of the site, an evaporative cooler was housed here to provide cooling through the stairwell. The condensation from this equipment concentrated moisture on both the tower space floor and the stairway walls, railing and treads. The equipment itself, by sheer weight and vibration, may have contributed to distress of the wooden floor, copper flashing (or pan) and the subflooring and framing. The cooler was removed ca. 1986⁸⁰.

FINDINGS AND ANALYSIS

The tower is not included on visitor tours, nor should it be included because the stairs are steep and not appropriate for general visitors.

The tower and the spaces it contains are viewed as part of the historic scene from some distance away on the ground. Its appearance from the distant vantage points should not be altered. This historic appearance does not require alteration in order to repair the floor system or the other elements needing repair.

79. Drawing No. 143/41029, sheet 10 of 41, also 143/41029B, sheet 23 of 36, both dated February 15, 1927.

80. Personal observation, John May to Craig Frazier, March 2, 1989.

Because the tower space is open to the elements, blowing rain enters unhindered. Over time, such moisture, combined with that of the condensation from the cooling equipment, deteriorated the flooring system. Although there is a drain at the southeast corner of the tower room floor, the slope of the floor does not appear to be adequate for rapid drainage. Consequently, water/moisture has seeped through into the building interior, resulting in water stained plaster and decorative wood ceilings in rooms below. Apparent efforts to prevent water intrusion with applications of caulking and tar coatings to the floor system have not been effective.

Deterioration of other materials and systems related to this tower space also need attention. As with other exterior wood elements, the wood ceiling of this tower space has been attacked by insects. Carpenter bees have drilled holes in the exposed ceiling beams and mud daubers have built nests on the ceiling. Cracks in the stucco are another source of water intrusion. The metal railings at the openings need treatment. Some unused electrical wiring needs proper protection.

TREATMENT ALTERNATIVES AND RECOMMENDATIONS

Some preservation maintenance treatment will arrest deterioration, but the tower space is being damaged by the elements and intervention is necessary. If interim treatment is seen as necessary, an epoxy coating on the wood flooring and sealant at the edges and at flashing seams or joints could be applied. This should be considered as temporary to reduce water penetration into the structure. The recommended treatments are as follows.

Flooring System

Replace the flooring system and related building elements as necessary to stop further deterioration and restore the watertightness of the system.

1. Provide protection of the work space from the weather. Plastic sheeting could be used in the tower openings, held in place with a padded compression frame against the sides and bottom of the openings. Some gap is suggested at the top to permit air flow for ventilation.
2. Remove the deteriorated materials of the flooring system. The existing wood tongue and groove flooring (1 x 4, Douglas Fir, or possibly pine, 3-3/8" exposed face) will most likely be found to be unsuitable for re-installation. It will be difficult if not impossible to remove because of softness from rot as well as brittleness from heat and dryness. Also rusted nails will often not release from the substrate, rather will tear through the flooring tongue edges.
3. Record with sketches, written descriptions and photographs, the historic and existing construction materials and details. Take samples for the building artifact collection. Record the materials and systems used for replacement.
4. Special protective and disposal measures will be required for removal of the white lead beneath the flooring. A historic material used like a moisture barrier, it will probably be found to be dry and powdery. Salvage copper flashing if possible.
5. Evaluate substrate materials at each stage of the work. It is quite likely that sub-flooring and at least some floor framing will need to be replaced. Replacement materials should duplicate the original as nearly as possible.

6. Install a moisture impenetrable membrane, heavy rubber or plastic sheeting such as used for pond liners, perhaps in conjunction with the original or new copper flashing or continuous pan, pitched to the existing drain at the original 1/4" per foot if possible.

7. Install new flooring to duplicate the original. To avoid nail penetration of the underliner, consider the feasibility of the flooring being a "pallet" on sleepers, unattached to the supporting system. This could also allow ventilation of the underside. Finish the flooring (all surfaces) with an exterior clear coating system.

Other Treatments

1. Install redwood dowels in carpenter bee holes. Select dowel size to fit the hole snugly. Use exterior carpenter's glue (or resorcinol glue) to secure; orient end grain of the dowel parallel to grain in the member. The length of dowels should be pre-sized to eliminate any need to trim or sandpaper its end once installed.

2. As far as is known to date, the only remedy for mud-daubers is periodic removal of their nests, best done at the early stage of nest building. The removal method recommended by the park staff is described in the wood chapter of this report. A frequent routine of mud dauber nest removal should be part of the maintenance program throughout the complex.

For additional detail on these insect problems, see the wood and pest management chapters of this report.

Screening of the openings of the observation tower is not recommended. There is no evidence of an original intention for screening to date, and this would be a visual intrusion.

3. Repair stucco cracks as recommended in the stucco chapter of this report.

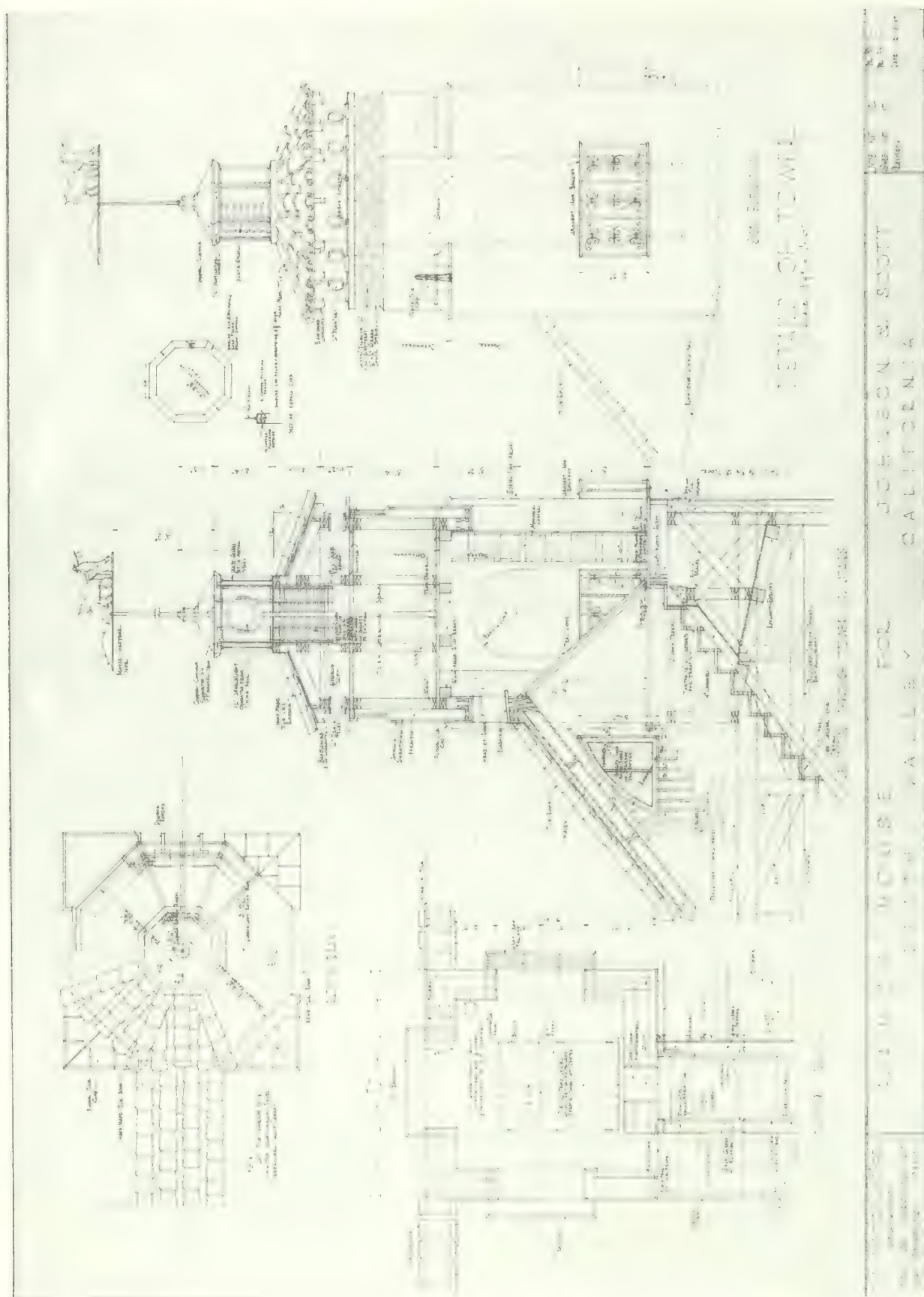
4. Provide preservation treatment (cleaning and coating) of the metal railings, resecure and replace missing elements (such as missing nuts or bolts). Refer to the metals chapter of this report.

5. Repair and refinish the stairway door and repair the hardware.

6. Install wire nuts on unused electrical wiring and inspect for integrity of wiring insulation. Install cover plates to protect wire and boxes.

EFFECTS OF RECOMMENDED TREATMENTS

Although some original fabric would be lost it is too deteriorated to retain and this deterioration is threatening more important structural and interior decorative features. The observation tower flooring in itself is not significant fabric, it is not seen by the public, and it does not impact the appearance of the structure. Replacement of this flooring would have no effect on the historic character of the building or on the historic scene. Replacement is needed to preserve the structure and important interior architectural fabric which is seen and interpreted.



Historic Drawing 1: Tower Detail, Main House

WOOD PRESERVATION

OBJECTIVE

Throughout Scotty's Castle, including most buildings in the Death Valley Ranch complex, there are numerous wood elements, from door and window surrounds, shutters, and railings to carved decorative beams and friezes. Most of the decorative wood, both exterior and interior, is redwood. Like many other material elements of Scotty's Castle, these wood features are significant character defining features because of the unique carved decorative designs, the finish treatments, and the craftsmanship exhibited in them.

This wood however suffers from the hot, dry environment. Shrinkage, ultraviolet degradation, extreme dryness and splitting are among the problems to be addressed in this chapter; recommendations for cleaning, preservation and repair are the objective here.

DOCUMENTATION

Historic Period

The following are excerpts from correspondence between Matt Roy Thompson and A. M. Johnson, also between C. A. MacNeilledge and Johnson or Thompson.

C. A. MacNeilledge to A. M. Johnson, Sept. 14, 1926 [27 ?] [from research notes in vertical files [5/1], SC, DEVA]:

Also received your letter regarding the doors and hardware, I would prefer them made of redwood principally for the color.

C. A. MacNeilledge to ...?... [on CAM letterhead], no date [from research notes in vertical files [5/1], SC, DEVA]:

[Bill for the cost of the doors. Broneer Art Door Co. Cost 1,080.20]

C. A. MacNeilledge to A. M. Johnson, January 31, 1927 [from research notes in vertical files [5/1], SC, DEVA]:

The wood ceilings are also very interesting. I have introduced very crude carved ornament on the face and soffits of the beams in your office, which I think the men on the job can do. In the small living room I have some band sawed ornaments on the cross beams and on the beams around the room at the angle I have carved in old Spanish letters a poem of the desert which will be brought out in faded old color. The details are not quite finished or I would send them all on to you, but as you expect to be out here soon you can see them all.

C. A. MacNeilledge to A. M. Johnson, February 25, 1927 [from research notes in vertical files [5/1], SC, DEVA]:

Bay window in your office is finished inside and out. Looks fine. I have stopped on the carving until you come. Trusses are being set.

C. A. MacNeilledge to A. M. Johnson, March 1, 1927 [from research notes in vertical files [5/1], SC, DEVA]:

I have delayed sending the enclosed details expecting you would be here before this. They will show what the carved inscriptions are to be. Also the crude carving which will have a bit of faded color rubbed in. I think it will lend a great interest to the interior as ornament and appropriate sentiment of the desert. The attached slip gives the literal translation of the Spanish. I hope you will approve as it will be very unusual.

Johnson to MacNeilledge (telegram), March 12, 1926 [27 ?], [from research notes in vertical files [5/1], SC, DEVA]:

Mottoes satisfactory for carving. Would like to add one or two. Will see you in LA Saturday, March 19.

Johnson to MacNeilledge (letter), March 12, 1926 [27 ?], [from research notes in vertical files [5/1], SC, DEVA]:

The mottoes are also alright, although I would like to have one or two from the bible also in the house.

Thompson to Johnson, May 16, 1927:

The beamed ceiling is finished in Scott's room; also in your bedroom and the kitchen; and the one in the solarium is being put in place. They all look very fine. [Page 1, paragraph 1.]

Thompson to Johnson, May 20, 1927:

Hoyt Brown, son of H.B. Brown, building superintendent, became very sick day before yesterday, and yesterday morning his right eye was swollen shut. His father and he attributed the trouble to fumes from the alcohol torch with which he had been burning redwood beams, and I have reported same to the State accordingly. [Page 1, paragraph 1.]

Beam ceilings are in place in the bedroom back of the kitchenette, also in Scott's room, your bedroom, your living room, the kitchen, library, and half finished in the kitchenette, living room, and upstairs living room of the west apartment. [Page 1, paragraph 5.]

Johnson to MacNeilledge, September 9, 1927, [from research notes in vertical files [5/1], SC, DEVA]:

Reviewing lumber bill from Woodhead and Consolidated that includes a lot of redwood and oregon pine.

M. R. Thompson to A. M. Johnson, November 7, 1928:

Painters are finishing the woodwork in the Main House, waxing and staining, etc, so that it makes a very beautiful finish. [Page 1, paragraph 4.]

M. R. Thompson to A. M. Johnson, December 15, 1928:

Painters are finishing the Kitchenette. The back room is done. [Page 1, page 3.]

M. R. Thompson to A. M. Johnson, January 1, 1929:

A carload of lumber arrived.... [May not have been finish lumber.]

Painters are finishing your bedroom and cabinet. Kitchenette and main kitchen and Scott's room have all been finished. [Page 1, paragraphs 3 & 5.]

M. R. Thompson to A. M. Johnson, January 8, 1929:

Painters are in your living room; and also are going over all hinge and other hardware to give them an aged look under Mr. MacNeilledge's directions....One painter, Mr. Guilbert the artist, is working in the music room adding bright color to the carved woodwork which is to be toned down finally to give an antique appearance. [Page 1, paragraph 3.]

M. R. Thompson to A. M. Johnson, February 3, 1929:

A carload of lumber arrived day before yesterday at Beatty from Hammond Lumber Co. [Included "Common Douglas Fir 1x6 S1S1E." Detailed report on charges. Page 1, paragraph 3]

M. R. Thompson to A. M. Johnson, February 10, 1929:

Inside plastering [of the barn] is waiting for creosoting of ceiling timbers which has been done in the west harness room and the passage room between it and the stable room. The rest of the ceiling will be creosoted in the next few days. We are using a spray pump for that purpose....

Painters are through in the main house except the living hall, living room and solarium which have not been started yet. [Page 1, paragraphs 2 and 3.]

M. R. Thompson to A. M. Johnson, February 15, 1929:

Painters are working on the ceiling of the living hall. There are only two painters now on the job, Guilbert and Chamberlin. [Page 1, paragraph 7.]

M. R. Thompson to A. M. Johnson, February 20, 1929:

The painters finished the music room, and the one remaining painter is working on the ceiling of the living hall. He is to be laid off soon, as Mr. MacNeilledge has ordered Mr. Brown to make a clean sweep of the old painters before sending up new ones. [Page 1, paragraph 8.]

M. R. Thompson to A. M. Johnson, February 26, 1929:

The woodwork in the rooms already finished by the painters looks very well. All the burnt soot has been brushed off and the wood stained and waxed to that it is clean and

looks antique. The one remaining painter is still working on the ceiling of the big living hall. Mr. MacNeilledge said in a recent letter that he is sending two more painters up, but I suppose they are waiting until he comes himself so he can start them in on the work. Expect him tomorrow according to his latest letter. [Page 2, paragraph 1.]

M. R. Thompson to A. M. Johnson, March 6, 1929:

Painters are now in the solarium and living room of the Main House. [Page 3, paragraph 2.]

Also March 10, 1929:

Painters are in the solarium, and also finishing up a few spots in the living hall. [Page 1, paragraph 3.]

M. R. Thompson to A. M. Johnson, March 14, 1929:

Carpenters are working on...and setting the screens in the lanas [sic] roof.

Painters are in the solarium, and also cleaning the walls of the living hall in preparation for waxing. They are using compressed air for this purpose, supplied by the spray pump bought recently to creosote the ceiling of the barn. It works fine. [Page 1, paragraph 3 and page 2, paragraph 9.]

M. R. Thompson to A. M. Johnson, March 21, 1929:

The painters are now finishing the annex rooms, and seem to be making good progress. [Page 2, paragraph 6.]

M. R. Thompson to A. M. Johnson, April 24, 1929:

The work in the main house is entirely finished [but exceptions were noted. Page 1, paragraph 7.]

M. R. Thompson to A. M. Johnson, May 24, 1929:

Painters are re-touching hardware, etc., in all the rooms of the main house as per recent new instructions from Mr. MacNeilledge. [Page 1, paragraph 5.]

NPS Period

Various finish and protective materials have been used in addition to those used originally (see below also):

16. The Park is well along on applying wood preservative to redwood surfaces such as lintels, shutters, etc. The product is a special redwood preservative. This work will be done on a continuing basis.⁸¹

The history section of this report describes work of this time in the following way:

A contractor was hired to apply linseed oil to the redwood on the exterior of the structure in 1977-78. This work was repeated by Park Service personnel in 1984. [From James O'Barr, "Notes on the Maintenance of Scotty's Castle, Building SC02, Main House and Annex", February 1990. History section draft, Section Q, Operation and Maintenance by the NPS.]

Recent efforts have been undertaken toward treatment of exterior non-structural wood deterioration. A Triple-X Assessment was submitted in June/July 1988 for initiation of an overall program for protection of "original, exterior redwood against weathering elements such as UV light, rain and temperature extremes" and for repair or replacement of deteriorated features.⁸² A supplementary Triple-X form was also filed for repair and replacement work for the screened porch of the Annex Lanai, also in June/July 1988.⁸³

FINDINGS AND ANALYSIS

The majority of the exposed wood of these buildings is redwood, both exterior and interior. Some is plain but the majority is highly decorative. Exterior elements include roof fascias, gable end trim, door and window headers, surrounds or trim, window shutters, doors, balconies and railings. Interior elements also include ceiling paneling, highly decorative beams, friezes, window shutters, wall paneling, railings and doors as well as built-in and free standing furnishings.

Many of the wood elements, both exterior and interior, were artificially "antiqued". This was done by lightly burning the wood surface with an alcohol torch, then brushing it to remove the char and give the surface a smoothness and slight sheen.⁸⁴ (The park preservation staff has found that soft brass wire platers' brushes work the best.) This "antiquing" was purposely done to varying degrees to achieve the effect prescribed, especially for the various interior room decorative themes. Other "antiquing" techniques were employed as well. Re-planing, scraping, chisel work, or other tooling was done to create surface patterns or the effect of re-used wood.

Although not immediately apparent, there is a great variety of interior wood finishes. The design theme or character intended for each room and the use or location of the wood element were

81. Memorandum from Regional Historical Architect, Western Region, through Acting Chief, Division of Cultural Resource Management, Western Region, and Associate Regional Director, Resource Management and Planning, Western Region, to Regional Director, Western Region, March 30, 1977, H30, XC3823. Preparation of 10-238's was recommended in a memorandum with the report from Associate Regional Director, Resource Management and Planning, Western Region, to Superintendent, Death Valley, April 4, 1977, H30, XA5427, XD24.

82. Triple-X Assessment, Preservation Maintenance, Exterior Redwood, Scotty's Castle, DEVA, July 1988. Attached to the Triple-X form is a Preliminary Inspection Report by Myrna Saxe Conservators of Art and Architecture, 4544 Tobias Avenue, Sherman Oaks, CA 91403 [?] [Tele. No. illegible], June 9, 1987.

83. Tripple-X Assessment, Preservation Maintenance, Annex Screened Porch, Scotty's Castle, DEVA, July 1988.

84. See letters from M. R. Thompson to A. M. Johnson, including May 20, 1927 and February 26, 1929.

determining factors for the choice of finish used. From room to room there are subtle differences in how wood is worked and finished. Because of some difference in how the wood is surfaced or finished there are few doors, or ceiling systems, or room trim groups that are exactly alike.

There is a range of finish systems, although most are a "minimum" finish, that is, heavy or solid coating systems were usually not intended, except for high use surfaces such as doors. The intent was to retain the natural appearance utilizing the wood grain and color and to create certain effects. Finish systems are so subtle it is often difficult to determine by eye what materials were applied. Some softening and fading from age is probably also a factor. Some elements do not appear to have received any finish coating after the surface texture or carving, burning and brushing were completed, but in fact did receive a finish. Stains are prevalent as well as various consistencies of clear coatings (linseed oil, or perhaps varnish, shellac or lacquer). The number of coats of clear finishes probably varied depending on the effect desired and the protection required. Doors and exterior wood received the most and heaviest coatings. Waxes were apparently used for some types of surfaces.

Stains were commonly used to alter the color tone of the wood. Ceiling systems and doors and their frames exhibit applications of stains depending on the scheme of the rooms. The two faces of a door may be finished differently, although close inspection is required to distinguish the difference. Doors were usually then finished with a clear coating for protection. (Whether the coating was linseed oil, shellac or varnish is not yet known.) In contrast, stained ceilings and other decorative surfaces in some rooms which would not normally be subjected to wear or soiling, appear not to have been given a clear coating.

Carved beams or other elements sometimes have detail highlighted with stain pigments or paint in red, green, yellow or blue. In the southeast alcove of the Great Hall the bookshelves surrounding the doorway to the Dining Room have decoratively carved edges. The carved design was highlighted with paint in all four of these colors.

The carved frieze lettering in the Lower Music Room was highlighted subtly with a red stain or paint (which tends to have an orange appearance). Some of the floral designs bracketing the lettering are highlighted with green. The carved designs in the underside of the beams were highlighted with green and yellow but only around the perimeter of the room, not in the main or secondary beams. The "faded" appearance was intended.⁸⁵

The carving in the beams of the Solarium was also highlighted in at least green, red/orange and yellow. In the Upper Music Room, the carved wood valance at the stage opening has highlighted detail in red, yellow, blue and green.

Wood Finish Types

Clear coatings of linseed oil were probably used on most exterior wood.

A beige (perhaps gray) stain was used in many rooms of both the Main House and Annex to create an aged effect as well as to lighten the wood color so that it reflects more light. In the Great Hall this stain was used on most of the wood, including the ceiling boards, trusses and

⁸⁵ See letters from MacNeilledge to Johnson, January 31, 1927 and March 1, 1927; also from Thompson to Johnson, January 8, 1929.

other exposed framing, and decorative elements. However, it appears that no clear coating was used in conjunction with the stain, but the use of wax was indicated.⁸⁶ This finishing in the Great Hall as well as other rooms took a considerable amount of time.⁸⁷ A contrasting finish is seen in the southeast alcove where the beige/gray stain was not used. Here the wood is darker. For protection the bookcases have a clear coating. The ceiling also has a clear coating but probably fewer coats as it has less sheen than the bookcases.

The Dining Room ceiling boards and beams also received this beige/gray stain, with no clear coating. As appears to be typical, this stain was applied after the woodwork was complete and installed. The doors have the same stain with a clear coating for protection. The ceilings of the Lower Music Room and Solarium were stained similar to the Dining Room, although the Solarium ceiling stain might be slightly heavier than in the Dining Room. The doors of the Solarium appear to have just a clear coating.

The beige or gray stain was also used on the ceiling systems of the Sitting Room of the Spanish Suite and the guest bedrooms and hall of the Annex. Some variation in density of application is seen, such as in the Spanish Sitting Room and Bokhara Room, where it appears to be somewhat lighter. Doors related to these rooms also received the beige/gray stain, including the Annex second floor bath, in conjunction with a clear protective coating.

Woodwork in the Annex Italian Room and Foyer might also have received the beige or gray stain. Although the NPS period linseed oil application darkened the wood, the variations of tone indicate variations of absorption, which might have been caused by stain resistance to absorption.

The Kitchen, Scotty's Room, the Spanish Bedroom and the Johnson Bedroom have a contrasting finish scheme. The wood color is darker and has varying degrees of clear coatings. Doors have the heaviest clear coatings. The interior shutters of Scotty's Bedroom have a light clear coating on the inside surfaces (as viewed when the shutters would be closed) while the outside surfaces have a heavier coating for protection. Whether a stain was used on the woodwork of these rooms has not been determined (a red or brown stain might be possible).

It appears that the redwood of the Upper Music Room of the Annex received a brown stain and one or more coats of a clear coating. Evidence of the brown stain can be found on door trim and elements of the stage grill woodwork.

Conditions

Ultraviolet degradation, dryness from sun/heat exposure, shrinkage, splitting, erosion from wind blasting, linseed oil build-up, insect attack, and rot are all typical problems, but the incidence and degree of severity varies considerably depending on exposure, and of course whether in an exterior or interior location.

86. Letter, Thompson to Johnson, February 26, 1929.

87. There are many references to the painters and "painting" (specifically staining and waxing) in letters from Thompson to Johnson: November 7, 1928, December 15, 1928, January 1, February 10, 15, 20, 26, March 6, 10, and 21, 1929. The staining of the Great Hall required at least from February 10 to March 10, 1929.

Rot. Because of the dry climate and the predominant use of redwood for exposed and decorative elements, the incidence of rot is relatively low. It has occurred however at locations often exposed to water, such as the bottoms of exterior doors and jambs, and at the bottoms of wood window grills and frames. In the screened Lanai of the Annex, extreme rotting was found in the joints of the structure. Other possible locations are window and door headers, eave and gable end trim, and any location where a projecting wood element is in contact with stucco.

Most visible framing is in good condition, but there are some observable locations where the potential for rot conditions exist. Examples are crawl spaces in the Annex, where dirt can be observed adjacent to or covering base plates and the bottoms of studs. Where accessible, soil/wood contact should be removed.

Mildew and mold has been identified at various locations, such as at the bottoms of doors and spreading from joints of various assemblies. It is identifiable by black streaks which start in the ends of a member at joints.

Insect Attack. The most common insects at Scotty's Castle that cause wood damage are carpenter bees and termites. The bees are easily observable but difficult to control. Termite damage on the other hand is not readily noticeable because the majority of wood framing on foundations or near ground level is inaccessible, hidden by the stuccoed wall systems.

Carpenter bees excavate (gnaw) their way into wood members. The exposed second floor framing beams of the Main House front porch is a location where this can easily be seen. Individual sites of attack can be treated but it is apparently difficult to provide a preventive treatment.

Termites were discovered recently in the sills and lower stud ends of the Cookhouse. This structure is a good example of unknown attack because the stucco and plaster cover does not provide accessibility to the framing for inspection, yet grade was found to be well above sill level at some locations, allowing easy attack by termites. From inspections in past years, at least the potential of attack had been noted at several locations in the Annex. As mentioned above, wood to soil contact should be eliminated at all accessible locations, both beneath structures and at perimeter walls. (Also see the pest management chapter of this report.)

Mud daubers are another type of problem. There does not seem to be evidence that these insects or their nests harm wood. The damage occurs indirectly from removal if not done carefully. Scraping is the most common cause of mechanical damage. Removal without damage to wood can be accomplished by crushing the mud deposit in on itself with finger or cloth then lightly picking up the remaining dust residue with a damp cloth.

Potential Damage from Monthly Pesticide Spraying. To control insects in the past, a pesticide was sprayed periodically around the buildings. Spraying was done with a portable tank unit. Building walls, especially the lower portions, and wood elements were subjected to overspray or airborne mist. Spraying has been discontinued by the park should there be the potential of damage to wood or wood finishes by spray chemicals. It was reported that the concessioner was still contract spraying around the Motel/Garage (Gift Shop, Snack Bar, Apartments) until about 1990. Various chemicals have been used over the years. Whether the chemical constituents of pesticides have an effect on redwood and their coatings or on stucco has not been determined.

Ultraviolet Degradation. Ultraviolet degradation weakens the wood cell structure, making the surface soft, and destroys the natural pigments, resulting in a faded grayish color.

Dryness. Dryness from sun/heat exposure and low humidity causes brittleness and shrinkage. Shrinkage of door and window headers leaves a gap at the interface of the wood and stucco, allowing water penetration. If the header is still sound it should not be replaced. Nor should the gaps be filled with stucco, a crack will still result. Allowance for expansion and contraction is necessary. The cracks can be carefully closed with a sealant. An acrylic or silicone/acrylic type can be used in a color as close to the stucco color as possible. These sealant types will be easier to apply and to remove for periodic maintenance renewal than butyls or straight silicones. If a clear sealant is used, it is suggested that the surface could be treated to be less noticeable by applying sand before the sealant surface has set. The surface of the sealant bead should be below the stucco surface to aid in achieving a neat and less visible application.

Interior woods have been affected by the extreme dryness as well. Cross-splitting failures -- failure of wood cells across the grain -- possibly caused by cellular collapse due to prolonged extreme heat and dryness are probably the worst interior wood failures that have occurred. The most severe failures are in the decorative carved beams in the Dining Room. The more prevalent failures, however, is splitting or checking of ceiling boards and beams. The monitoring baseline is the 1979-82 condition survey.

Even though the woods are extremely dry, ceiling systems and many other features should not be treated with linseed oil or other oils because these treatments normally darken the wood. Improved humidity control will be a major benefit for wood stabilization in the buildings.

In 1982 a linseed oil coating was applied to the ceiling and exposed framing in the Italian Room, the double doors of that room, and the foyer woodwork. Because this turned the wood dark, all interior linseed oil application was stopped. It was thought that the original material might have been a cut shellac or cut varnish, or perhaps no sealer at all.⁸⁸ However, as noted above, this wood may have been stained and no clear coating applied (except for doors, shutters and similar features which need protection).

Erosion. Dirt and sand particles carried by strong winds erodes the wood, removing the softer spring growth rings more than the harder summer growth rings, leaving a very ridged surface, which absorbs more water than a smooth surface. The ridges are also easily crushed, making refinishing more difficult.

Cleaning and Care of Interior Wood. One of the more prevalent causes of wood damage has been from maintenance activities, as found in the 1979-82 condition survey (see summary listing below). Over the years, cleaning has probably caused many of the nicks, scars and dents, but other maintenance activities have most likely caused them as well.

Bits of lint and cleaning cloth threads have lodged in rough, splintery wood. Dusting of woods having only stains or light coatings, should be done with a vacuum having soft bristles in good condition so other parts of the head do not touch the wood. Dusting cloths or mops should not be used. There is very little furniture type highly finished wood in the buildings, so generally the use of dusting cloths is not recommended. To prevent scratching wood surfaces during cleaning, the most obvious rules are never to use implements or methods which would be likely to cause scratches, and always to exercise care.

88. See August 1982 Update Notes in the "Scotty's Castle Historic Structures Condition Study" by George Voyta and Don Creech, DEVA, 1979-82.

Linseed Oil Build-up and Degradation. Over many years numerous applications of linseed oil, predominantly on exterior wood, such as doors, has resulted in heavy, caked and dirty deposits. In locations of extreme exposure, this build-up has dried and shrunk to a hard, crazed deposit, no longer providing protection. In protected locations and on many interior surfaces however the finishes are still sound and serviceable, although other problems or damage may exist.

Baseline Condition Survey

From the condition survey done between 1979 and 1982 a set of condition categories can be indicated for interior wood. Approximately 476 deficiencies were logged:

1. Dryness splitting and checking and cross-grain failure of wood cells (43), (9%).
2. Gaps between wood members or between wood features and other materials (61), (13%).
3. Various types of damage, wear or problems related to hardware, primarily on doors (56), (12%).
4. Wood broken, loose, missing or damaged or soiled, often caused by maintenance activities (102), (21%).
5. Normal wear, some vandalism damage (147), (31%).
6. Water stains (27), (6%).
7. Rot (1), (--).
8. Warpage (2), (--).
9. Insects, or evidence of previous insect infestation (15), (3%).
10. Rodent damage (7), (1%).
11. Paint, wax or other stains (15), (3%).

Preservation Process

In the original work, after decorative wood elements were carved to the intended design, it was "antiqued" by controlled scorching with an alcohol torch to highlight certain details of the design. Apparently a typical original finishing material was linseed oil, which was often used as a maintenance coating until recently. Known applications are noted in the inspection attached to the previously cited Tripple-X assessment:

Exterior:

1930.....Boiled linseed oil stain
 1947 through 1970....Linseed oil
 1978.....Clear Watco Penta
 1980.....Boiled linseed Oil
 1984.....Raw linseed oil

1986.....On shiplap siding, trial removal of previous coatings and application of pigmented preservative /coating.*

Interior:

1930.....Waxed**

Unknown.....Linseed oil on half of Italian Suite^{89***}

[* The memo does not indicate the location; the reference is probably to buildings at Lower Vine Ranch.]

[** It is most likely that not all wood was waxed.]

[*** Probably 1982-83; all of Italian Suite and Foyer.]

That same inspection report described some of the general and specific conditions:

In sheltered areas the various coatings have darkened and crosslinked, in some cases causing expansion and splintering. Other damage on exteriors includes drying, warping, splitting and degeneration of end grains, particularly in areas of southern exposure.

Interior wood exhibits some cracks in ceiling beams and beam movement. These cracks appeared in 1983 and have since enlarged. A small crack appeared in the dining room table in 1978 and has since enlarged. Surfaces are generally in good condition.

The recommendations contained in the 1987 inspection report for removal of coatings was to use "A solvent based, neutral pH, water soluble paint and epoxy remover containing Methylene Chloride, methanol and a thickening agent. Do not use acidic or alkaline chemicals." [and] "Water, low in dissolved salts, if possible." For refinishing a pigmented alkyd based preservative was recommended.

The 1988 Tripple-X Assessment described the general problems as:

The exterior redwood on the listed buildings has been deteriorated by 65+ years of exposure to severe desert environment. Among the destructive characteristics are prolonged high temperatures, excessive ultra-violet light, particle burdened blasting winds, occasional saturating rains and freezing temperatures....[And]...a surface build-up of linseed oil which is cracked/ checked....The original burned color is faded, the linseed oil is unsightly, the surface wood fibers have been damaged or eroded away and the grain suffers from shrinkage cracks and checks. Damage also exists from normal wear and tear, abuse and insensitive alterations, as well as improper repairs.⁹⁰

The supplementary Triple-X describes the condition of the screened porch structure of the Annex Lanai and the proposed work on that structure:

89. From Preliminary Inspection Report, Myrna Saxe, Conservators, July 9, 1987, attached to July 1988 blanket Tripple-X assessment for Exterior Redwood preservation.

90. Ibid., n. 1.

It is proposed to duplicate and replace approximately 50% of the ceiling screen frames, nearly all screen moldings and replace screening material as required. The porch screen doors may require total disassembly & regluing. One of the front support posts needs to be raised approximately 1 1/4 inches and secured appropriately in its proper position.

These repairs are necessary because screen frame and trim deterioration has caused pieces of redwood to split off and fall to the porch floor or blow off the screened ceiling. This has resulted in the loss of some screening material....The porch screen doors appear to have failed glue joints, causing damaging drag at the tile floor...one of the front support posts has dropped and racked adjacent framing & screen units out of square....

The destruction of some historic fabric during its removal is unavoidable due to its extremely fragile, deteriorated condition. This will be especially true in the rebuilding of ceiling screen frames....The heat and UV light has resulted in such dry, cracked wood that reassembly nailing/gluing is questionable, even if a successful disassembly is possible.⁹¹

The proposed treatment procedures are described in the assessments. After experimentation with materials and techniques, a process has been developed which appears quite successful. A paint stripping booth with heating, cooling, ventilation and humidity control has been constructed for work on members removed from the buildings. The accumulated layers of linseed oil (and sometimes other finish materials) are removed with a marine grade paint and varnish remover, which takes a number of applications and careful removal with bristle brushes to minimize raising of the wood fibers, which occurs very easily with the soft redwood. The stripper residue is removed with a fine water spray. After drying the wood can be sanded and repaired. However, very little sanding has been done because it removes too much material.

Rotted or otherwise deteriorated wood is removed. Epoxy resin repairs have been successfully accomplished, recreating rotted post or beam ends or mortises, or filling surface voids. The epoxy is pigmented to match as closely as possible the finished wood color.

For finishing, a pigmented alkyd oil preservative stain is applied to match the original color.

When it is necessary to replace members, clear heart redwood, mostly vertical grain, is used. To accurately duplicate molding profiles, the park preservation staff custom grind shaper and router blades.⁹²

91. Ibid., n. 2.

92. Materials Proposed or Used

Stripper:

(Proposed and used) – El Pico, marine grade paint and varnish remover, No. 6324. Methylene Chloride base. It was found to be more effective and have less effect on the wood if it was applied, allowed to "dry", another coat applied, then brushed off; followed by successive double coat applications. Warm water gently sprayed at a raking angle should be used for rinsing, with soap in the final rinse.

Epoxy Resins:

Conserve 100 Consolidant

Resin	56 oz	(full can)
Hardener	18 oz	(full bottle)

(continued...)

92. (...continued)

1/2 batch	28 oz	resin
	9 oz	hardener
3/4 batch	42 oz	resin
	13.5 oz	hardener

Structural R 1000 Epoxy
5 to 2 ratio by weight

For grey color:

14 oz batch	7 TBS	Raw [Umber?]
	4 TBS	Burnt [Umber?]
	2 TBS	red
	4¼ tsp	black

7 oz batch	3 TBS &	
	1½ tsp	Raw Umber
	2 TBS	Burnt Umber
	1 TBS &	
	1½ tsp	red
	1¼ tsp	black

Rottex Epoxy (for surface treatment)

1 part resin
1 part hardener
50% micro-balloons
1/8 tsp powder red
1/8 tsp powder black

Aggregate:	Washed sand or silica sand, not more than 30%
Micro-balloons:	Extender, not more than 50% (more than 50% weakens mix)
Cabasil:	Thickener, add until desired consistency is obtained. (Caution: change occurs suddenly).

Finish:

Interior/exterior preservative stain, oil alkyd, semi-transparent, water repellent, REZ, by Pittsburgh Paints, S/T mixing base No. 77-860.

Pigments: "pigment in oil tinting color", obtained from GSA.

Stain mixes, per gallon of preservative:

New wood
1 liquid ounce.....Raw Umber
1 liquid ounce.....Burnt Umber
1/8 teaspoon.....black

Old wood
2 liquid ounces....Burnt Siena
1 liquid ounce.....Burnt Umber
1/8 teaspoon.....black

Replacement Wood

Redwood: Clear Heart, vertical grain unless otherwise required.

From preservation staff notes made during the work on the Lanai screen enclosure, some observations on their findings on stripping, epoxy repairs and refinishing are noteworthy:

Work began August 1, 1988 with recording the structure (drawings and photographs). During experimentation with stripping procedures, it was noted that the wood color for a fair depth was brown and faded, the result of penetration of ultraviolet radiation, and the caution was not to try to remove the faded, brown wood as it would remove too much material.

This condition would imply that the surface wood cells are deteriorated and should be removed to sound wood, either by sanding or planing. This would reduce the dimensions of the piece however and alter the proportions and appearance of the assembly as well as the fit of the pieces. This would mean small pieces would have to be replaced, and decisions made as to the advisability of retaining possibly deteriorated wood or to remove it and how the member would be affected.

It is noted that acidic or alkaline strippers should not be used on redwood, rather that it should be neutral. Non-neutral chemicals attack the wood acid and pigments. However, Methylene Chloride and/or methanol strippers are considered toxic, hazardous materials.⁹³

93. Reference: Kemnitzer, David A., "Paint Removal from Historic Interiors", article in "The Interiors Handbook for Historic Buildings, edited by Charles E. Fisher, III, Michael Auer and Anne Grimmer, Historic Preservation Education Foundation, Washington, D.C., 1988. Also see article bibliography.

This article discusses the use of two recently marketed strippers, Peel-A-Way and Dietrich 404 Rip-Strip, but these are caustic formulations, thus probably not usable for redwood. The article discusses other types in general.

For some history on clear coatings, see: Purser, Michael W., "Historical Wood Floor Finishes and Contemporary Wood Floor Finishes", and the article bibliography, in *ibid*.

Also see: Knight, Katherine, "Restoration Material in the 1990s: California Leanin' is Becoming a Reality", *The Old House Journal*, November/December 1989, pp. 28-31.

This article on alternative coatings and strippers discusses several which may or may not be possible options. "Safest Stripper" by 3M is described as containing dibasic acid esters, other ingredients and water, has no exposure limits and is non-caustic. Two strippers by AFM Enterprises, Inc. are "MF" for general paint stripping, and "Stripper 66", for clear finishes only. These are water based and do not contain methylene chloride or trichloroethane, and are described as having been developed to "minimize chemical exposure to the user". The article does not however indicate whether any of these strippers are neutral. Also mentioned is newly emerging technology of citrus-based products which in the future may hold some promise.

The alternative paint stripper suppliers listed in the article are:

AFM Enterprises, Inc., 1140 Stacy Ct., Riverside, CA 92507, (714) 781-6860

3M D-I-Y Division, Wood Refinishing Products, P.O. Box 33053, St. Paul, MN 55133
(800) 548-6527

Alternative wood preservative suppliers listed are (no technical data is given):

Auro Natural Paints, Sinan Company, P.O. Box 181, Suisun City, CA 94585

Livos Plantchemistry, 2461 Cerrillos Rd., Santa Fe, NM 87501, (505) 988-9111

Preserva-Products, Inc., P.O. Box 744, 2955 Lake Forest Rd., Tahoe City, CA 95730-0744

California air quality legislation (and in a growing number of other states) limits the volatile components of coatings and other compounds. In the future, this may result in the need to find alternative materials. Some are now available and experimentation may be advisable.

In the work notes, it was indicated that hardware could be left in place, which would reduce damage to the wood or the hardware, and the old finishes removed from both the wood and the hardware. However, the disadvantage is that old finish, and stripper/finish residue is probably left behind the hardware. The back side of the hardware cannot be cleaned and treated if left in place.

To prepare the wood for refinishing, it can be burned with a propane torch, carefully, to a light to medium brown, then brushed carefully with a soft brass brush. However, the preservation staff is doing very little burning or reburning based on the idea that there is the potential for too much material loss, or when wood must be refinished in-situ they do not want to have a potential fire hazard, so they are using stains for color variations. In cases when items can be removed to the shop, such as doors, reburning could be done, or burning of replacement wood to match the original. In either approach, matching the surface and color appearance can be a problem and will probably need to be determined on a case-by-case basis.

The pigment colors and mix depends on whether the wood is old or new wood. Old wood takes pigment having an apparent reddish tone (actually Burnt Siena, Burnt Umber and black), whereas new wood takes a more brown stain (Raw Umber, Burnt Umber and black).

The bottom ends of the Lanai posts were set originally in a pocket in the tile deck. Of course, this pocket held water and the ends of the posts rotted away. After removal of the rotted wood, also around beam mortises, the missing wood was replaced with epoxy. An epoxy consolidant (Conserve 100) was first applied to the wood, then the missing part reformed with structural epoxy (Beta R 1000) with a sand aggregate and reinforced with fiberglass dowels into the wood member. The structural epoxy is held below the finish surface level because it is too hard to be tooled, and a final mix is applied for tooling to create the wood appearance. This "cosmetic" coat (Rottex epoxy) is toolable -- it can be pigmented, sanded, chiseled, drilled, etc. For new mortises, a new redwood block was epoxied into the member, allowing for nailing into the wood block. Concrete colorants were used for the epoxy because if liquid universal pigments are used the quantity required weakens the epoxy.

ALTERNATIVE TREATMENTS

In general, consideration of alternatives with regard to wood preservation is not whether treatment should or should not be done. Where wood elements have deteriorated, treatment is recommended. There are wood elements, however, that are in good condition and no treatment is recommended at the present time. These elements or systems are typically the interior decorative ceiling systems or other elements. Although treatment may be necessary in the future, improved climate control and good maintenance will preserve these materials for many years.

The questions of alternatives here relates to when action should be taken, what types of treatments are appropriate for the degree of deterioration, and the materials and methods which will achieve the best or correct results, all relative to the characteristics of the wood element and its original finish treatment. Overall, the best treatment is good, consistent maintenance. Some actions are indirect -- notably provision of improved climate control for interior wood preservation. For already deteriorated wood (which is most prevalent on the exterior of the

buildings) case by case evaluation must be exercised and treatment decisions made based on the degree of deterioration and the technology and expertise available. Extremely deteriorated wood usually needs to be replaced (and should be replaced in-kind with the same species and grade of wood and the same finish). In some cases consolidants or other compounds can be used to repair a member. In others, less drastic treatments or refinishing can preserve original fabric.

RECOMMENDED TREATMENTS

Care and Cleaning (Housekeeping)

Do not use cleaners on woods which are unfinished or that do not have protective finish coatings. On woods which have a uniform protective coating, such as doors, and when soil removal is needed, mild detergent and water can be used sparingly. Do not use furniture polishes on any building woods.

Periodic dusting should be done with a vacuum with a soft bristle brush attachment. Cloths or dusting mops should not be used.

When lubricating hardware (door hinges), pull the hinge pin, clean and lube, and put it back in place. (Do not spray lubricant on hinges or other hardware -- overspray stains the adjacent wood and stucco.)

For worn pintle hinges (primarily on exterior doors) which cause a door to drop and rub on the floor, the staff has successfully used inserts of washers made from fiberglass rod. From the correct diameter rod, cut a disk of the needed thickness, then drill a hole of the diameter of the pintle. There has not been a need to treat or finish the edges of the washers.

Routine Preservation

When wood elements are refinished or replacements are installed, provide a record of the finishes used, as well as maintenance materials to use and frequency of maintenance finish applications.

The period of maintenance coating renewal varies depending on the location. Exterior wood with high exposure to the sun and other elements may require recoating on a yearly basis. In protected locations, especially in interiors, the interval may be as much as ten years.

Restoration Treatment Priorities

For the on-going treatment program the following generalized criteria are suggested for setting priorities and planning year to year treatment work:

Priority	Category
1	Exterior woods with high sun, wind and water exposure: <ul style="list-style-type: none">a. Complete Lanai screen structure.b. Wood elements in high sun exposures exhibiting high degrees of degradation, including Dining Room bay windows, Sea Horse Room

exterior door, window headers, balconies, Upper Music Room window hoods and east window shutter, Flag Tower entry door; exterior doors subject to rain splash such as the Main House Kitchen door and north Great Hall entry door and its grills and surrounds.

- c. Eave and gable trim, beams, rafters and other projecting elements.
- d. Shutters

- 2 Interior wood elements, usually doors, where existing damage threatens stability:
 - a. Repair malfunctioning door hardware.
 - b. Doors with broken parts, doors which drag on floors, or any condition of damage which may cause additional damage or increasing rate of wear. Some of these may be interim or partial work rather than a complete restoration of the element.

Restorative Treatments

Linseed Oil Removal. The system which has been developed has been well researched and tested and is yielding good results. Experimentation is suggested with some of the new stripping agents which are becoming available to reduce the toxicity and volatiles release problems. This may be necessary to comply with increasingly stringent California standards pertaining to release of volatiles in paints and other coatings and removal agents.

Dryness and Splitting. Combating the splitting and cross-grain wood failures which are caused by the climatic dryness, heat and UV/visible light degradation will require adequate funding and prioritization. Repair and refinishing exterior wood elements should receive high priority to reduce loss. The Lanai structure was an obvious high priority choice. Window surrounds and doors with high sun and water exposure are high priorities.

The highest priority for preservation of interior woods is provision of a climate control system. Otherwise many elements need no treatment.

Repairs. Malfunctioning hardware and loose or broken members should be repaired to prevent additional damage. (See criteria above).

Replacement. Continue present policy of obtaining replacement wood of the same species as the original and as close as possible to the original grain and color characteristics.

Refinishing. Refinish original wood or finish replacement members in same scheme as original (surface treatment of wood, stain colors, coatings). If for reasons of toxicity, availability, serviceability, longer life, or greater protection, new substitute coatings can be used as long as the finished appearance will be the same as the original. The techniques and materials which have been developed by the park preservation staff for treatment of the Lanai screens and frame appear to be successful both technically and aesthetically and are recommended to be continued, with adaptations made as required for future treatment of other elements. Further testing and finish design formulation will be needed however for interior systems (see further study recommendations below).

Moisture Protection (Separation Between Wood and Other Materials). Where separation has occurred between wood members such as door and window headers and stucco, install a sealant

to reduce water intrusion. These gaps are needed by the materials for expansion and contraction but also need to be sealed to prevent water entry into the building walls and the wood elements. The sealant needs to be unobtrusive in color, easily removed when necessary without damaging adjacent materials, installed neatly and slightly below surface faces, and installed with bond breakers behind where necessary to provide the proper proportions of the seal for movement.

Moisture Protection (Finishes). As recommended above, wood subjected to moisture (and other weathering) should be given as high a priority as possible for repair and refinishing.

Rot. Remove, to the extent possible, the conditions conducive to rotting action. Along exterior building walls and in crawl spaces where accessible, eliminate earth to wood contact and provide adequate separation between grade and the level of wood framing.

Termite Control. To reduce the potential of termite attack, the action recommended above to reduce rot potential will also reduce termite attack somewhat. However, where possible and where not visible, it is advisable to add termite shields at wall framing sills. Schedule regular termite inspections and provide treatment when needed in conformance with the park Integrated Pest Management Program.

Stains. Removal of paint, wax or other stains is recommended as a low priority for treatment unless the condition is causing additional damage. Otherwise, these can be attended to when major work on the element is required.

Pesticides

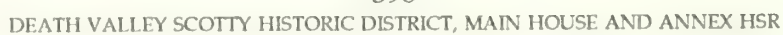
A determination by a wood treatment/entomology expert should be sought on the possible effects of chemical constituents of pesticides on wood, wood finishes and on stucco or other building materials. Assistance should be available from the cooperative extension services of one or more of the California universities. Another source is Mr. Joe Capizzi, Extension Entomologist, Oregon State University, Cordley 2046, Corvallis, Oregon 97331, (503) 754-3151; or Professor Robert D. Graham, Department of Forest Products, Oregon State University.

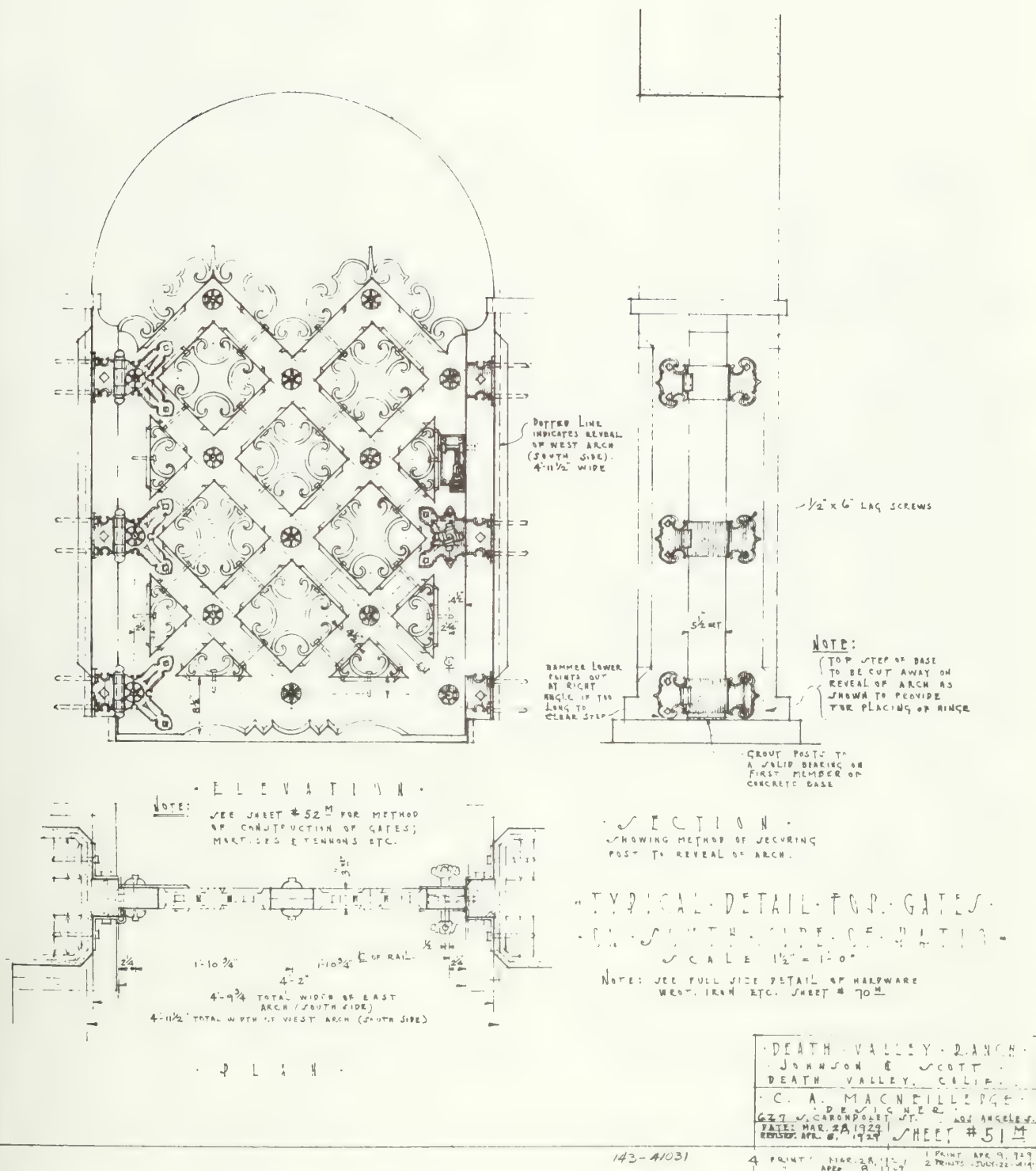
Recommended Further Studies

Obtain a finishes specialist (wood finishes conservator or furniture conservator) to analyze the various finish materials and systems. This could either be accomplished as a complete analysis or on an as needed basis or a combination of both. Such a person needs to have a knowledge of historic finish systems, testing methods, and substitute materials to achieve the historic appearance if use of historic materials is not advisable.

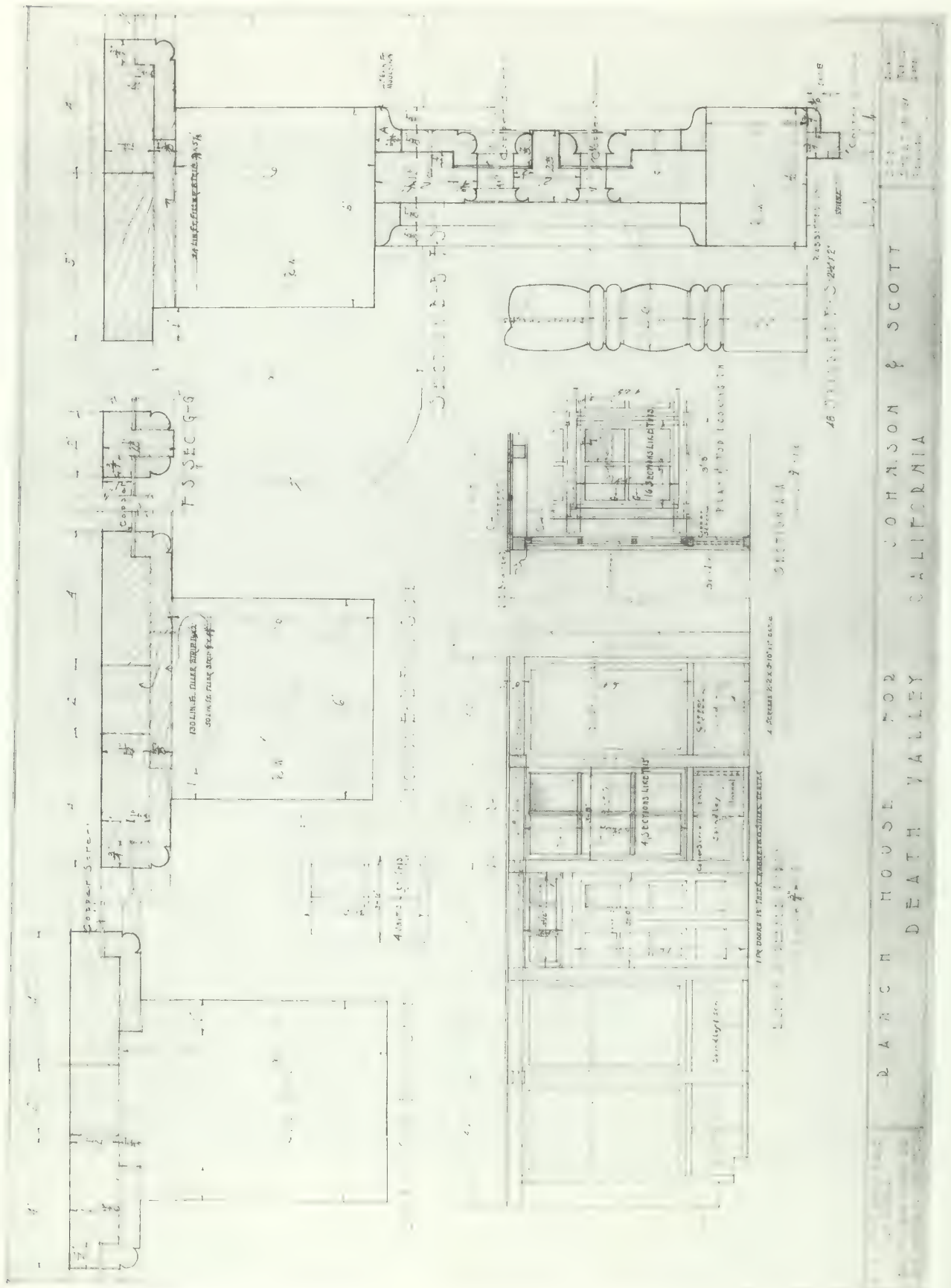
Determine Munsell color numbers of the highlighting of the carved designs in various wood elements, including the Great Hall alcove bookcases, frieze lettering in the Lower Music Room, Solarium beams, and the Upper Music Room stage valance. Determine the type of colorant used for the highlighting, whether paint or stain. Verify the intensity characteristics. Based on historic documentation that muted, faded color was intended, it is believed that the present appearance is similar to the historic. Fading is probably not significant because curtains and shutters have probably been closed more often than not, in the historic period as well as during both the Foundation and National Park Service periods.

The Munsell color numbers for the various general wood stains should also be obtained. These stains occur on ceiling paneling and beams, trims and doors. In many cases samples should not be removed so color matching will need to be done in situ. This will require taking the needed equipment and materials to the site.

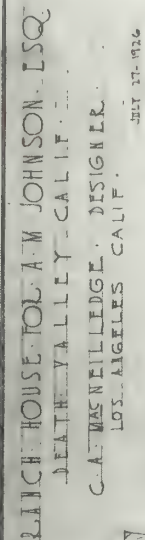




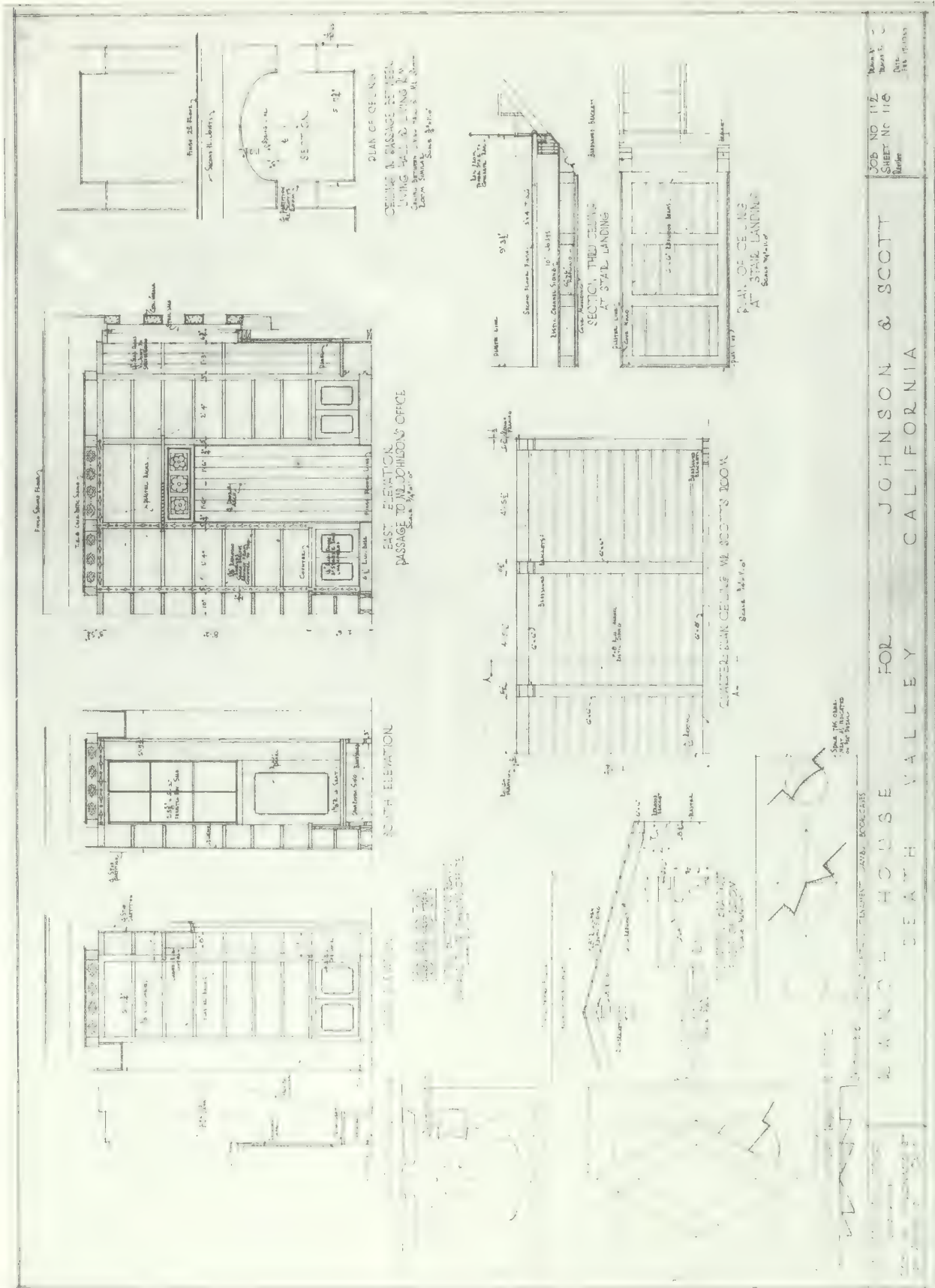
Historic Drawing 2: Gates on South Side of Patio



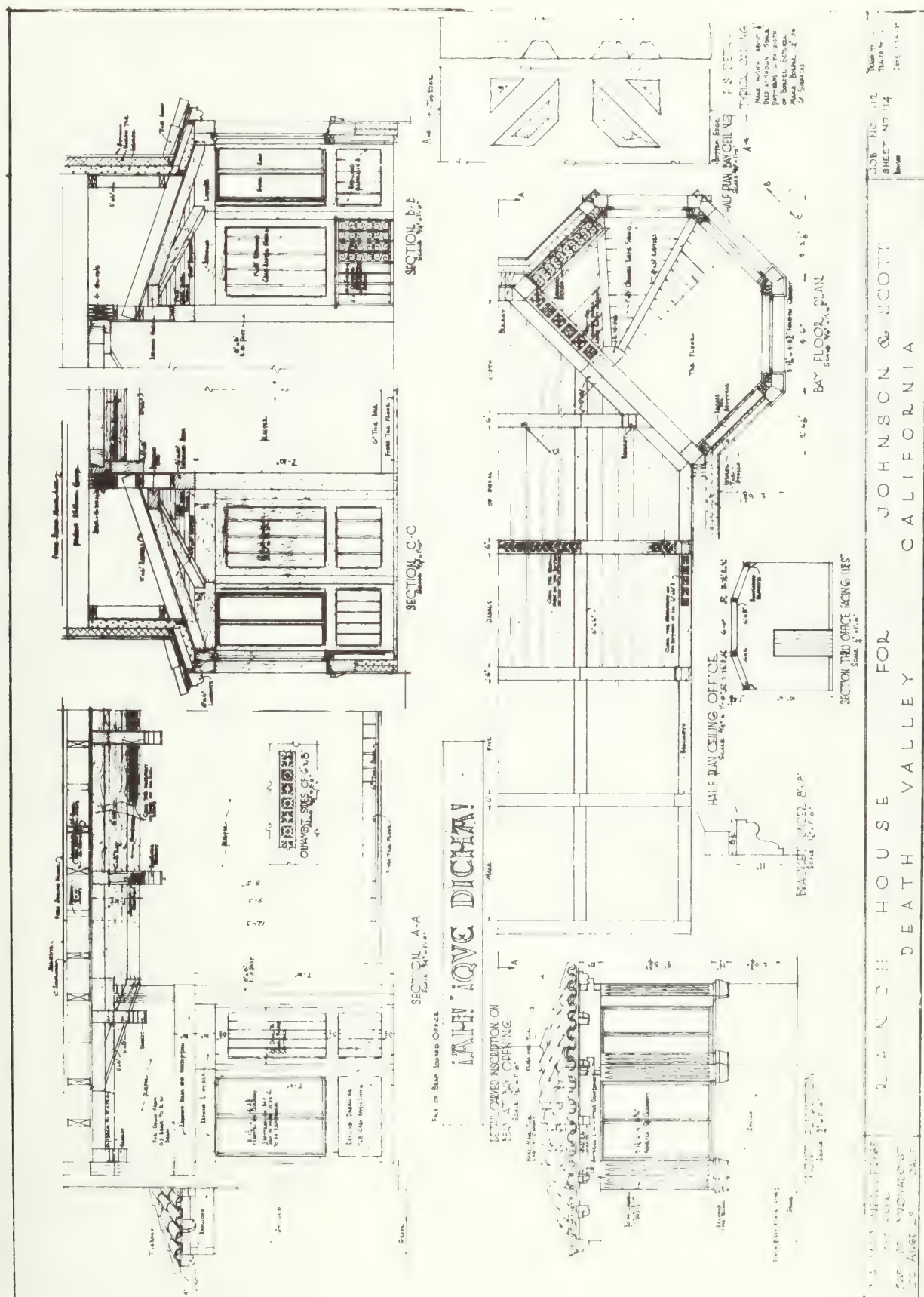
Historic Drawing 3: Lanai Screen Enclosure Details



Historic Drawing 4: Gallery Details

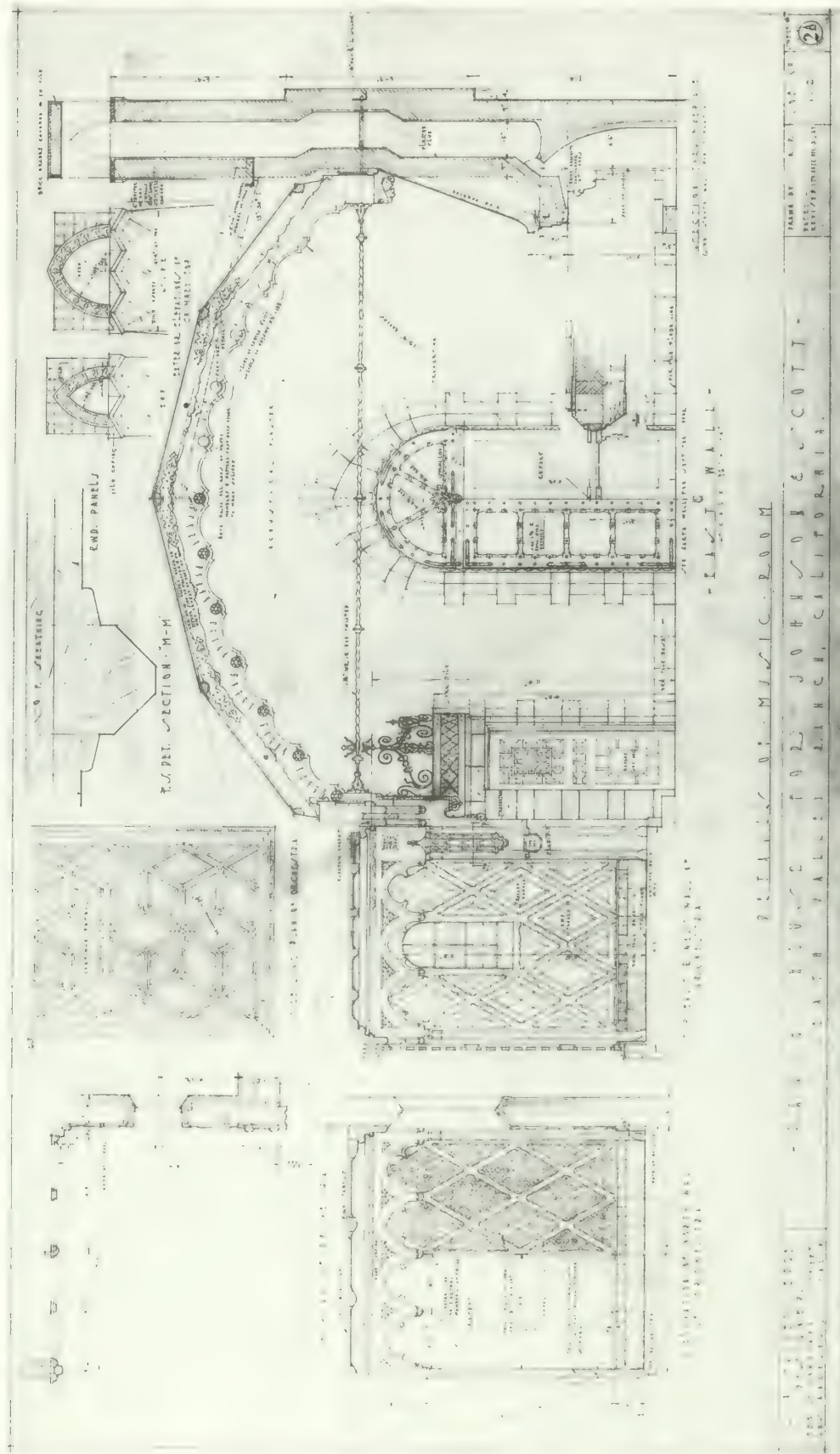


Historic Drawing 5: Woodwork Details Including Southeast Alcove, Great Hall

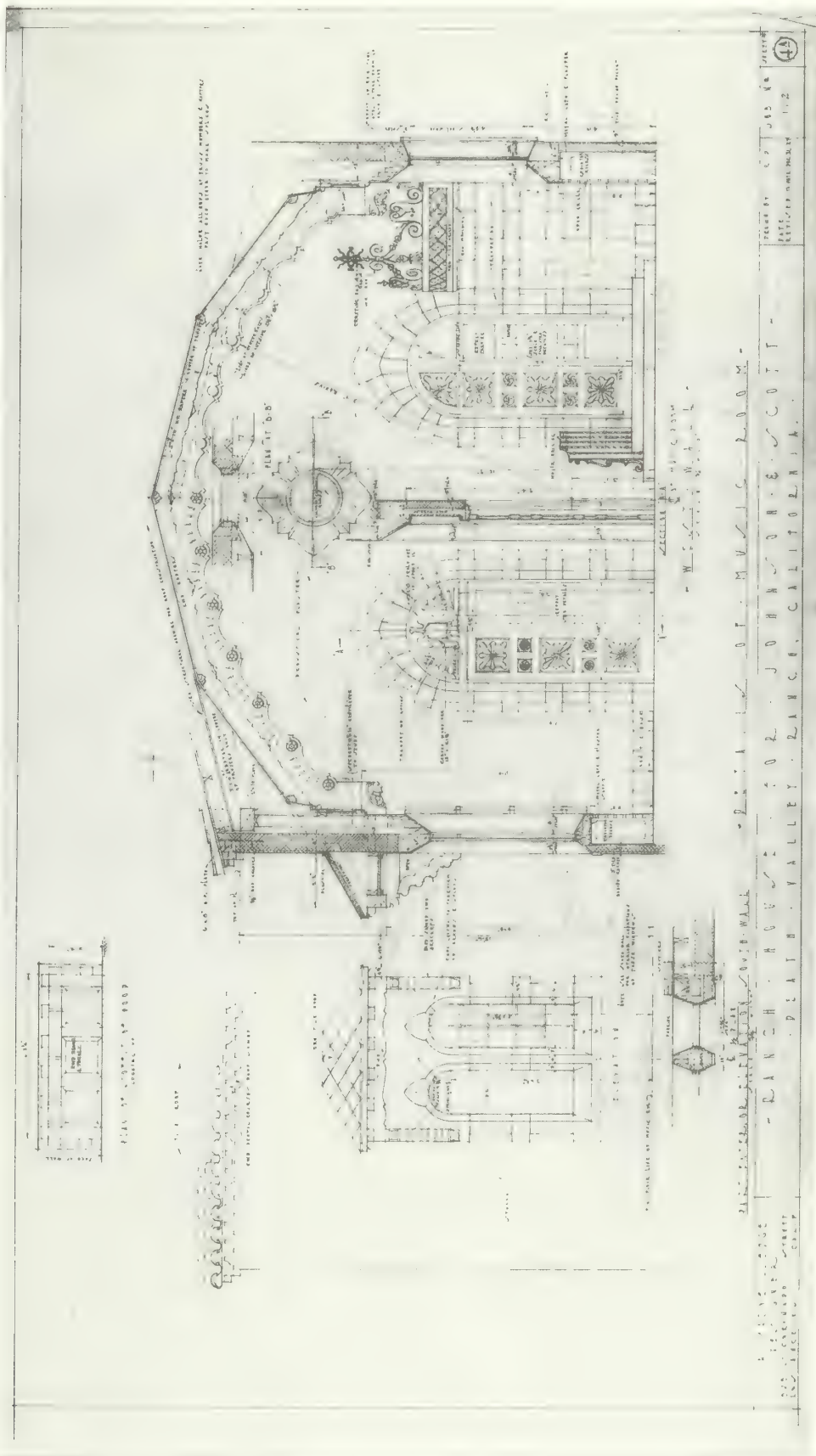


Historic Drawing 6: Dining Room Bay and Ceiling

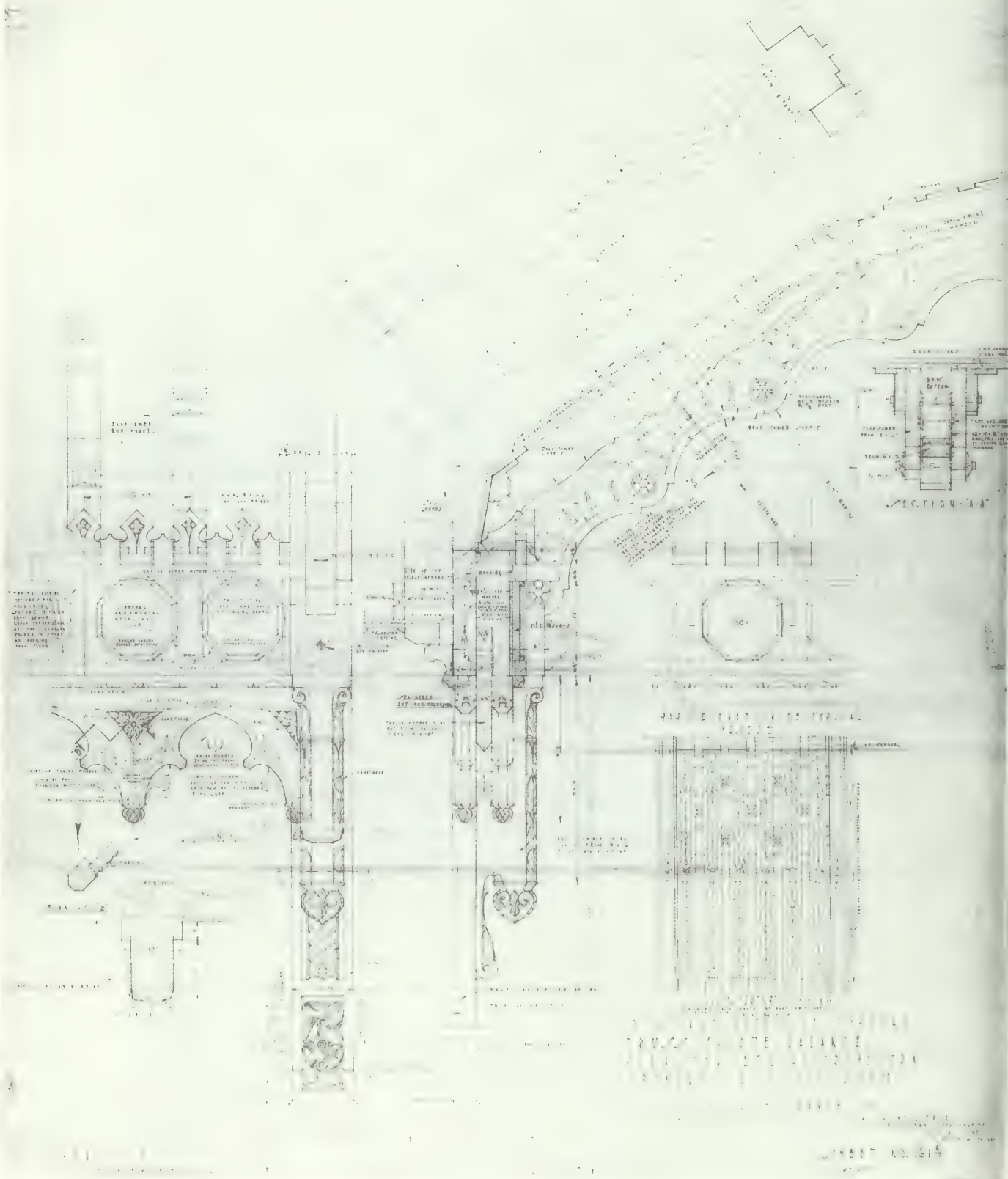
Historic Drawing 7: Lower Music Room Details



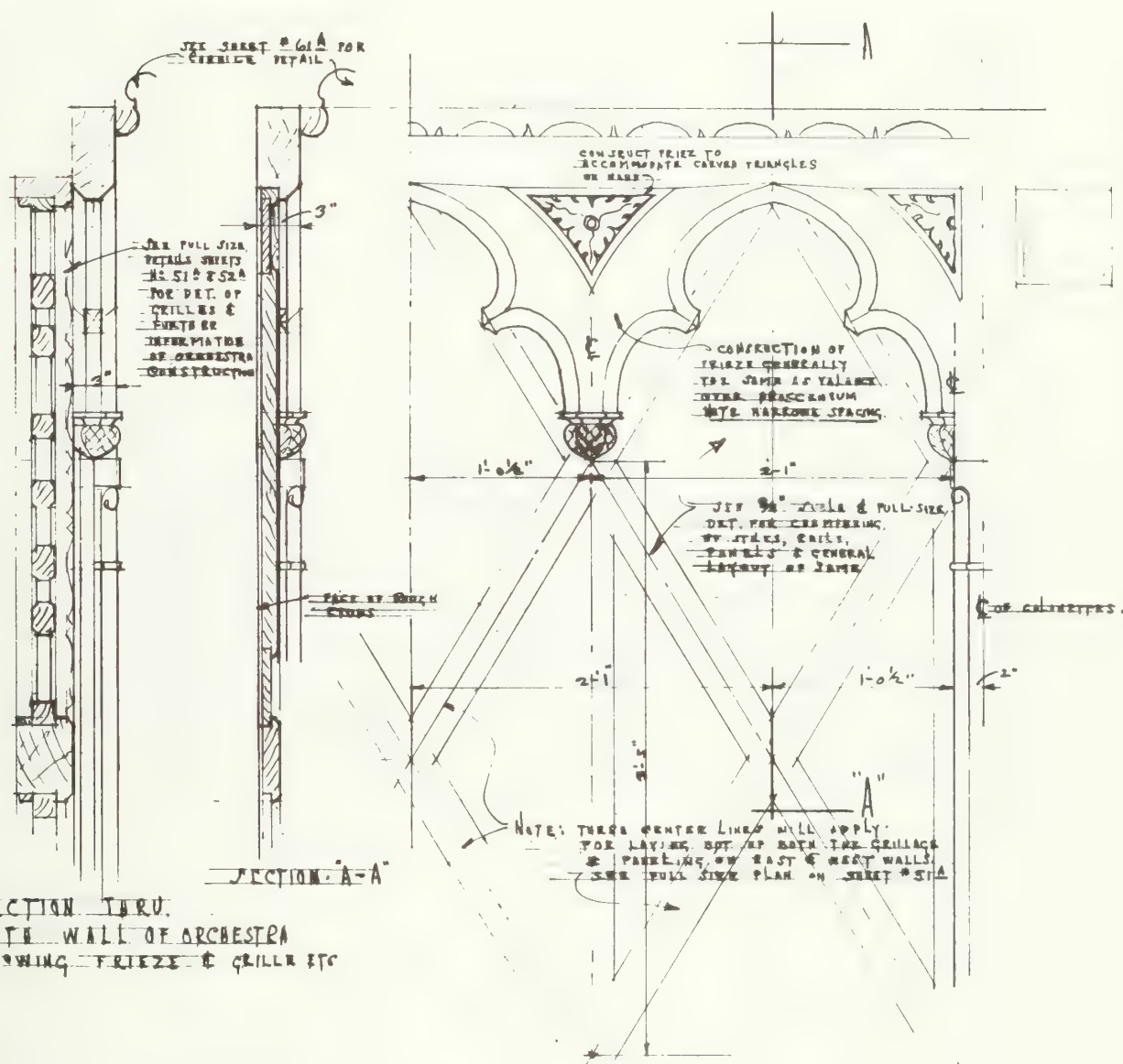
Historic Drawing 9: Music Room Details, East Wall



Historic Drawing 10: Music Room Details, West Wall



Historic Drawing 11: Orchestra Opening Details in Music Room



3" SCALE DETAILS OF FRIEZE IN ORCHESTRA
 SHOWING ITS RELATION TO GRILLE & ALSO TO PANELING
 ON EAST & WEST WALLS

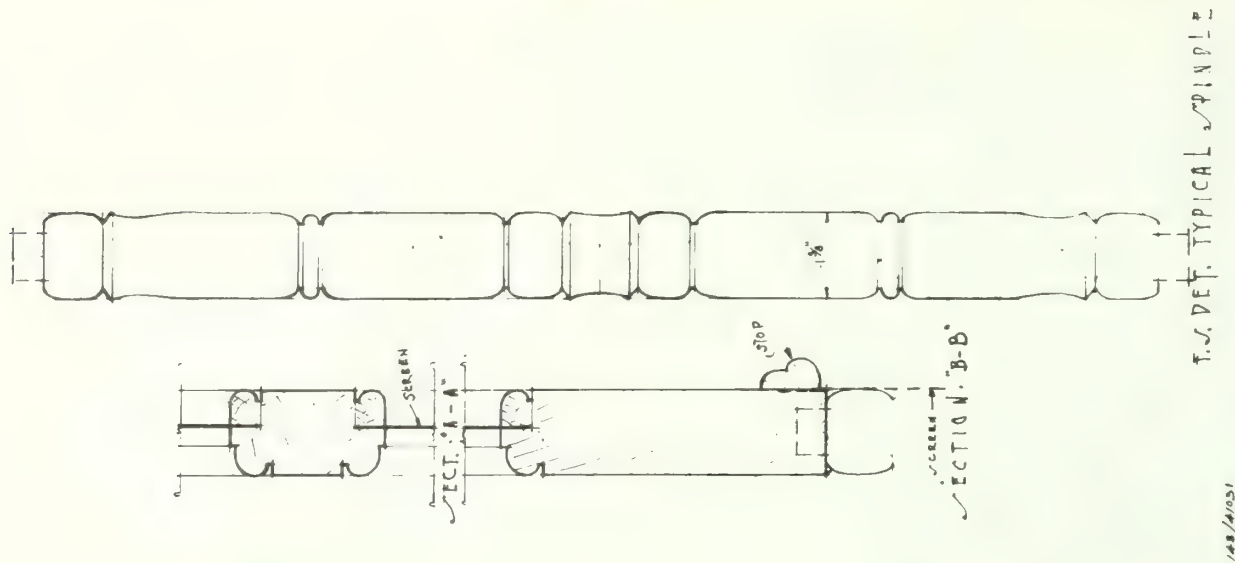
DEATH VALLEY RANCH

JOHNSON & SCOTT
 C. A. MACNEILLEDGE - DESIGNER

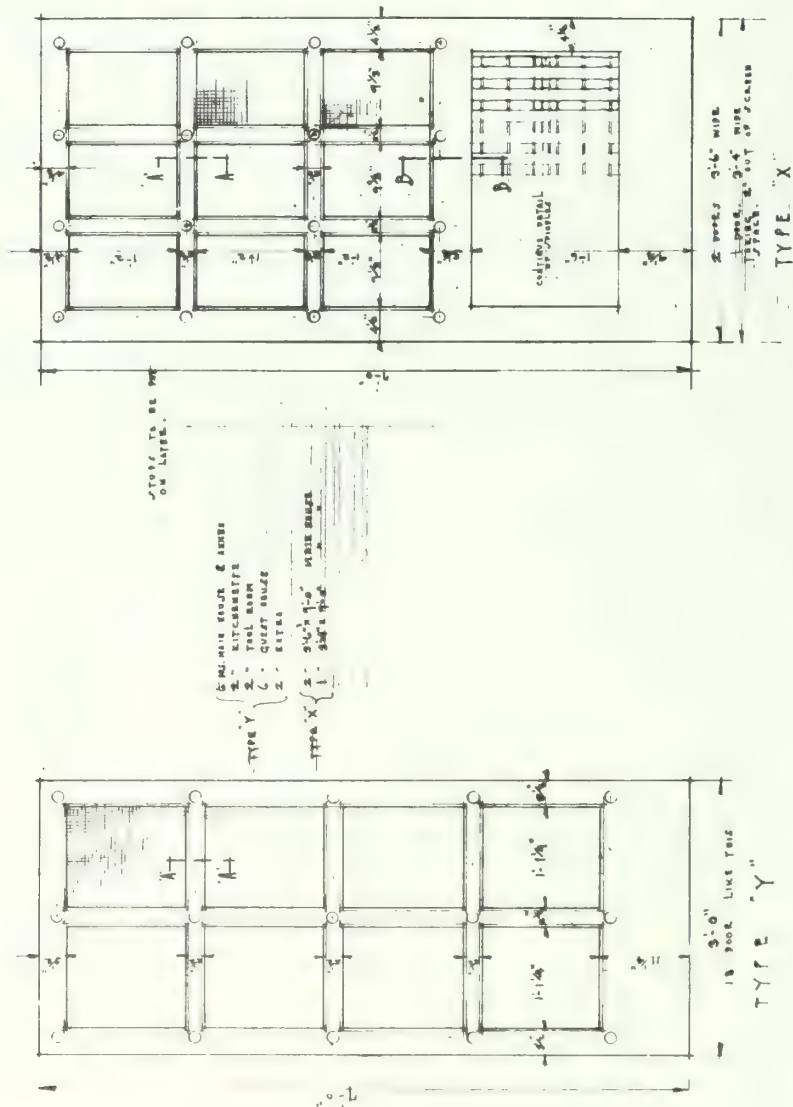
MAR. 22, 1922

SHEET # 401

Historic Drawing 12: Frieze Details in Orchestra, Upper Music Room



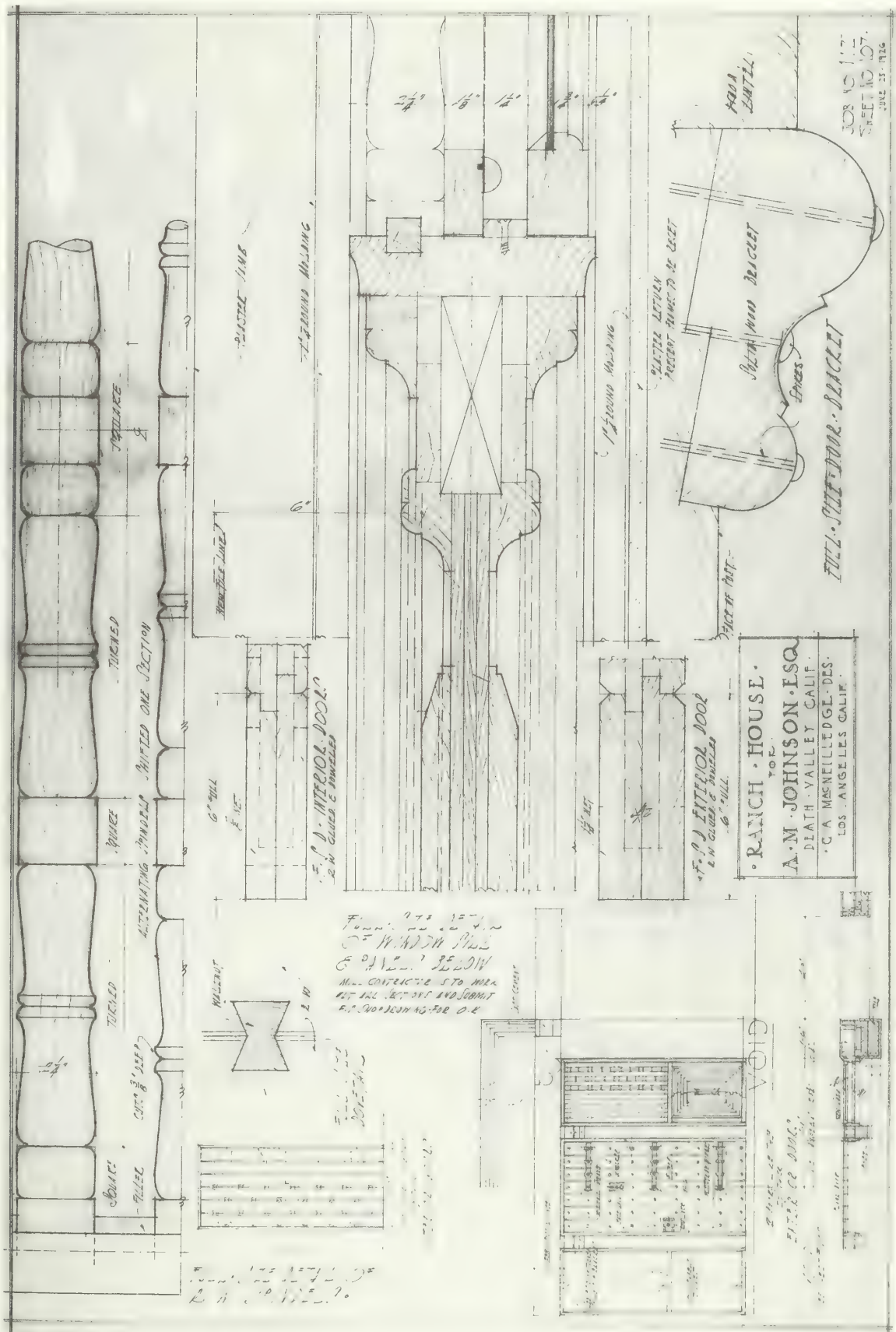
148/4/251



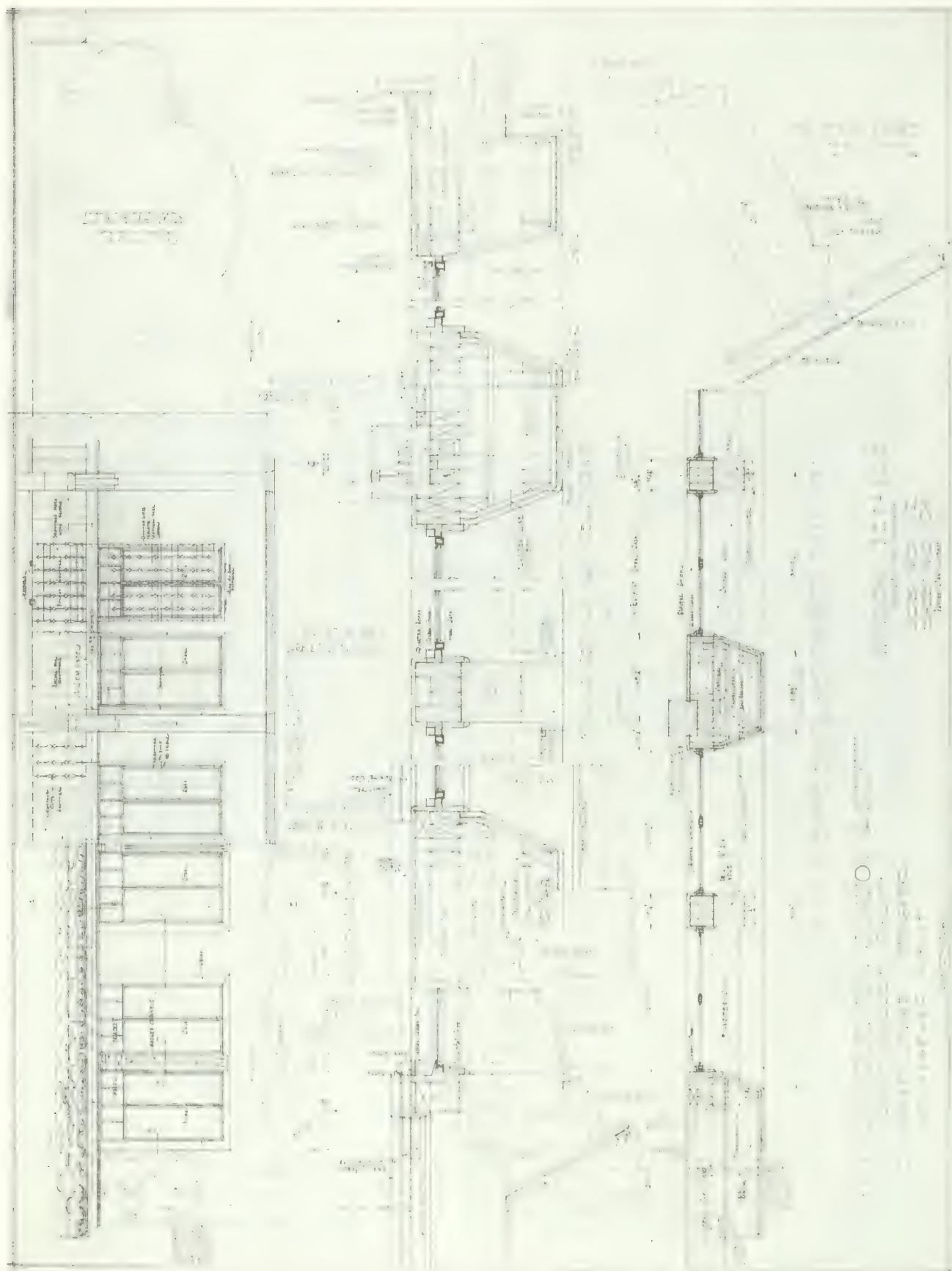
SCREEN DOOR DETAILS
DEATH VALLEY RANCH

C.R. MACNEILL/PCF

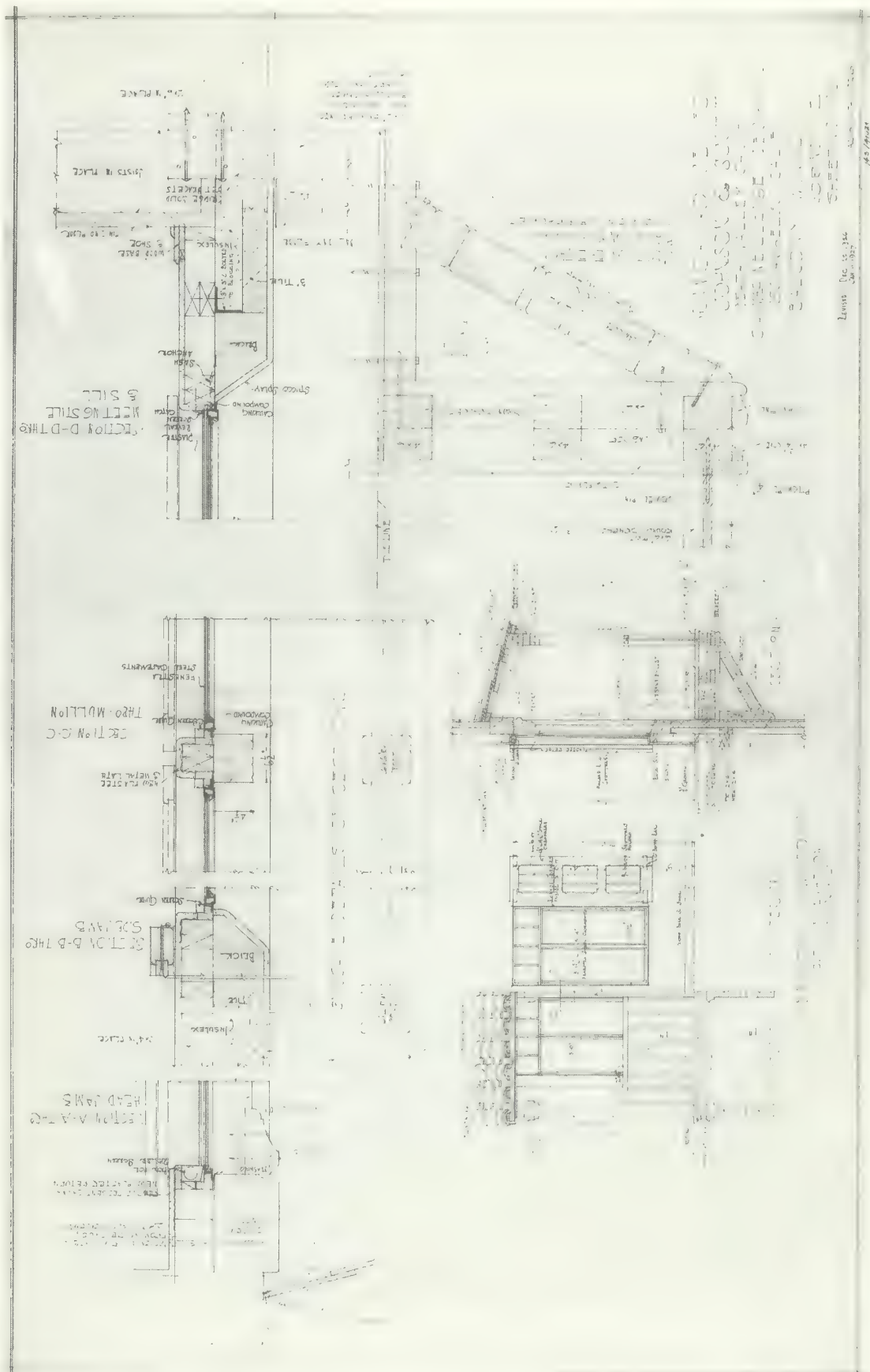
Historic Drawing 13: Screen Door Details



Historic Drawing 14: Door and Window Panel Details



Historic Drawing 15: Window Details



Historic Drawing 16: Balcony Windows, Main House



Photo 1: Main House, north entrance. Greatest weathering of wood and hardware at bottom of door and panels. R.L. Carper, 4/90.



Photo 2: Kitchen entrance and windows, Main House. R.L. Carper, 4/90.

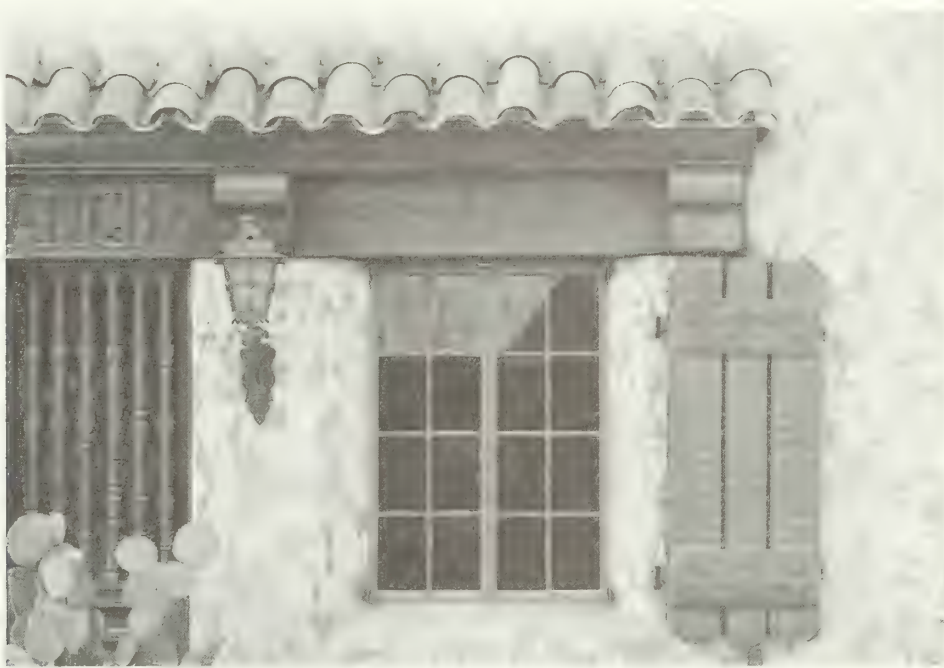


Photo 3: Window details, Main House. North entry showing surface tooling ("antiquing") of wood shutters. R.L. Carper, 4/90.



Photo 4: Turned wood grill, Annex. Dry and checked by weathering. R.L. Carper

Photo 5: Door, Lanai to Upper Music Room, Annex. Highly crafted door suffers from weathering. R.L. Carper, 4/90.



Photo 6: Window hoods, south wall of Upper Music Room, Annex. Wood is extremely dry and weathered from exposure to sun, wind and moisture. R.L. Carper, 4/90.



Photo 7: Great Hall Gallery, Main House. Some wood elements, including the trusses, are tooled ("antiqued"), others are plain. All of the wood is stained. D. Snow, 1990.



Photo 8: Southeast alcove, Great Hall, Main House. Wood bookcase and door surround with carved detail color highlighted. R.L. Carper, 4/90.



Photo 9: Ceiling detail, Lower Music Room, Main House. Wood is stained and carving is color highlighted. R.L. Carper, 4/90.



Photo 10: Main House, Solarium ceiling detail. Another example of stained wood with color highlighted carving. R.L. Carper, 4/90.



Photo 11: West door, Scotty's Bedroom, Main House. An "antique" appearance was created by the highly tooled wood surface. R.L. Carper, 4/90.



Photo 12: Historic photograph, Italian Room, Annex. Frasher photo, 1931. S-0555 (A 308), DEVA 15942. The wood was undoubtedly stained, but had a lighter appearance than today because of a recent application of linseed oil.

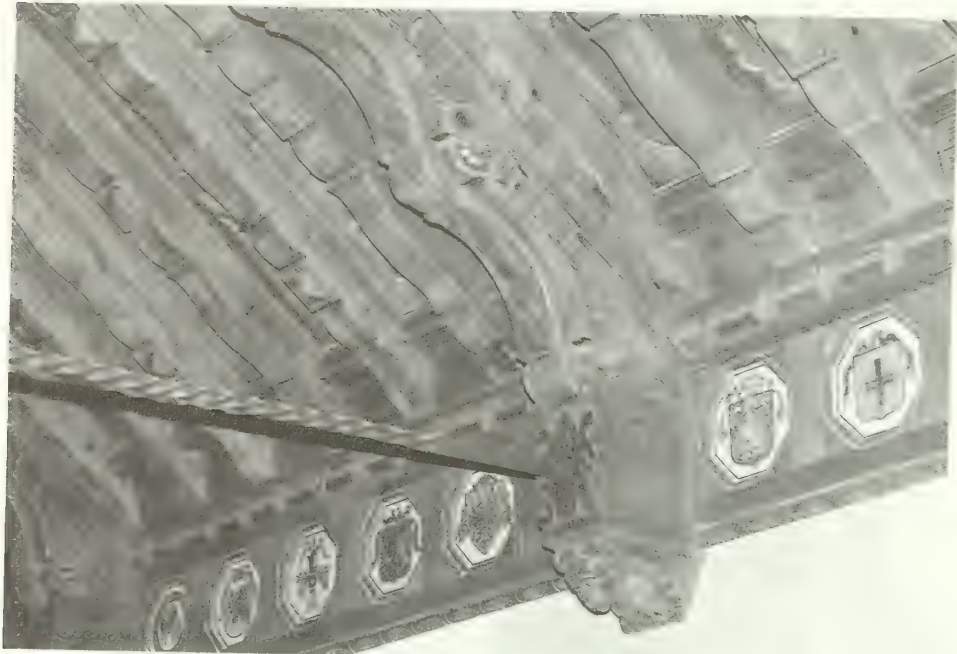


Photo 13: Ceiling detail, Upper Music Room, Annex. The wood in this room is also stained. Splitting is evident from extreme dryness. R.L. Carper, 4/90.



Photo 14: Detail of Orchestra frieze, Upper Music Room, Annex. Carved detail of the valance is color highlighted. R.L. Carper, 4.90.

METALS AND GLASS PRESERVATION

OBJECTIVE

The objective of this chapter of the report is to identify, analyze and document the architectural characteristics of functional and decorative hardware, glass, and windows. Recommendations for treatments and further study will be presented in as much depth as feasible to be in keeping with the scope of this report.

It is important to note that all of the items discussed in this chapter, which consist of metal or metal and glass components, are considered as being character defining features contributing to the overall historic significance of Scotty's Castle. The basic categories are as follows:

Doors	Hinges, Latches, Bolts, Straps, Locks, Decorative Connectors
Windows	Frames, Sash, Glass, Latches, Hinges, Window Covering Hardware, Shutter Hardware (hinges, straps, dogs), Interior Screens, Window Grills
Fireplaces	Hoods, Andirons, Screens
Structural	Gussets, Rods, Decorative Connectors, Brackets
Mechanical	Decorative Grates, Radiator Grills
Electrical	Chandeliers, Observation Tower Cupola, Ceiling Mounted Fixtures/Wall/Furniture mounted Fixtures and associated Glass, Switch Plates
Architectural	Stair Assemblies, Stair/Balcony Railings, Decorative Screens and Crests, Roofing, Courtyard Gates, Weather Vanes, Sundial (Shadow Bar), Bullet Splitters, etc.

DOCUMENTATION/CHARACTER DEFINITION

One of the most unique, and certainly the most "tailored" aspects of Scotty's Castle is its hardware. Numerous pieces were custom designed specifically for the space (interior or exterior) it was to be associated with. This was particularly true of doors and light fixtures. In only a few instances were the hardware items consistent (i.e. metal window sash, screen door hardware). The vast majority of hardware components were designed specifically or chosen from specialty hardware stock (by A.C. MacNeilledge's office) to be in keeping with a particular room's motif. This thematic bias is also reinforced on the exterior of doors leading into a particular space.

The following is an architectural description of what is perceived to have been, or is, the intended character of various hardware items using the seven basic categories outlined under Objectives.

Doors

Strap Hinges. Both interior and exterior surfaces of doors have, with very few exceptions, highly ornate strap hinges that stretch anywhere from a third of the way across the face of the door, to all the way across. They are held in place with decorative metal studs that varied considerably in configuration. In some cases the studs themselves are incised and grouped with iron keys as the primary decorative application to the door (photo 1).

Among the most extreme examples of strap hinging are on the main entrance doors, and the entrance door to be the basement Changing Room for the pool (photos 2 through 6).

Butt Hinges. With few exceptions, the large decorative strap hinges were welded to "off the shelf" Stanley butt hinge sets. The hinge leafs themselves were finished with the same "Old Iron" antiquing as the rest of the door hardware, however they lack any of the distinctive hand tooling. The hinge pin caps, or finials, are a different matter, and were designed as decorative components to be in keeping with a particular door's theme.

Applied Finish. One of the most consistent details relative to door hardware is the way it was finished to an "Old Iron" appearance. It appears to have a hand rubbed antique finish with high parts of the metal allowed to be brighter than low parts. Upon closer inspection, pigment can be seen in the crevices where hand tooling, chased lines, and hammering have distorted the surface. There may have been several applications of finish, the first possibly being a black lacquer (hand rubbed to allow highlights), the second a somewhat translucent brown (paint, varnish or stain). The additional finish treatment on some doors appears either orange, green, or tan, depending on where the door is located. These latter colors are quite subtle, almost to the point of being unnoticeable unless the piece is closely scrutinized.⁹⁴

Hand Tooling. The metal itself was hand tooled to a high level of detail on both strap hinges and studs. Again, an extreme example of this attention to detail can be seen in the stipple hammered "starfish" on the basement Changing Room door (photo 4). It is difficult to know exactly whether the casting may have provided the detail or the hand tooling, but it is none the less quite visible, providing numerous different textures to the composition. These tooling marks are called out in the original drawings (see historic drawings).

Door Pulls. The thematic, fanciful character of each space was strictly adhered to, hardware being one of the most obvious implements in the designer's pallet. Once again, sampling the Changing Room door, a finely detailed three dimensional "seahorse" pull-handle exemplifies this devotion to a nautical theme (see photo 2).

Latches. Locking, latching and strike hardware components were hand tooled and antiqued to match specific door characters as established by strap hinges, studs, and hinges. Interior surface mounted latches and sliding bolts appear to have been purposely over scaled to be in keeping with the castle motif, and designed originally for use with padlocks.

Exterior Weathering. It is important to note that the appearance of much of the exterior door hardware's appearance has been effected by weathering (a detailed discussion will follow under Existing Conditions/Analysis).

94. M.R. Thompson to A. M. Johnson, January 8, 1929, Page 1, paragraph 3: "Painters are in your living room; and also are going over all hinge and other hardware to give them an aged look under Mr. McNeilledge's directions."

Windows

Frames. All window frames and sash are painted metal (an olive drab color). The only exception to this are the leaded glass sash in the Upper Music Room. The vast majority of windows are a consistent, manufactured design with multiple and fixed lights (see HABS drawings for configuration). They are casement type, externally hinged, opening out. One notable exception is the window in the Solarium on the first floor of the Main House. It has only one fixed, non operable, light (south west corner), apparently to take advantage of the view. It is doubtful if any paint has been applied to the window frames and sash since construction (photo 7).

Glass. The glass is clear, much of the original material appearing to be in place. Replacements are obvious because of the contrasting white glazing compound (Original work still has olive drab colored paint.). Again, an exception are the leaded glass sash in the Upper Music Room.

Weathering. Similar to the doors, it is important to note that weathering has had a major effect on the character of windows (A detailed discussion will follow under Analysis of Existing Conditions.). The intended appearance of the windows can easily be seen by looking at the interior clerestory windows on the second level of the Annex, where the windows have always been protected from weather and ultraviolet light deterioration.

Window Covering Hardware. Highly ornate iron window rod brackets (photo 34), rods, arched tapestry frames (only in the upper Music Room) graced almost every room (an exception being Scotty's Room). As with door and lighting fixture hardware, the metal was designed and finished to match the motif of the room in which it was installed. The iron window covering frames in the Upper Music Room are highly stylized to the extent they are accented with decorative antique brass elements to contrast with the black iron.

Shutter Hardware. Many of the windows are equipped with operable shutters. The hardware on these wood plank shutters consists of strap hinges, studs, slide locks, and wall mounted shutter dogs (photo 9).

The appearance of the strap hinges and related shutter hardware is purposely hand hammered and worked, varying somewhat in style and quality. They appear to have had the same "Old Iron" finish as the door hardware, though have suffered a great deal more due to weathering.

Window Grills. There are several patterns of window grills used to guard against ground floor Annex and Main House basement window access. They appear in a very weathered state, however, there are signs of green paint on some of them where surfaces have been somewhat protected from the weather (photo 8). It is likely they were painted when installed, which means their intended character would be quite different from the rusted appearance which can be seen today (see historic and HABS drawings for actual configuration).

Interior Screens. In certain locations, insect screens were installed on the interior (primarily the great hall). They roll up into a metal tube mounted above the operable window heads and ride a metal track on both the left and right sides of the window frame (photo 34). They are finished the same olive drab color as the window sash and frames.

Fireplaces

With respect to fireplaces, there are metal components (copper, iron, brass) used in conjunction with other materials, to varying degrees, throughout the complex. They include decorative (hand tooled) hoods, screens and andirons. They pick up on the theme of the rooms they are part of, with some accent use of brass (shields), but the majority of the finish is "Old Iron" (photo 10).

Structural

There are a number of locations where structural work is intended to be visible in the form of tie rods, gussets, and bolts. The finish on the majority of these components is "Old Iron." Gussets are particularly similar to the strap hinges on the doors in configuration and texture (hand tooled).

The overall appearance of structural hardware, throughout the building, appears to be one of rust (simple iron deterioration). Upon closer scrutiny, however, there is an applied finish that seems to have been chosen to replicate the appearance of rust, or "Old Iron." In some cases, where there is actual rust, it is nearly impossible to tell the difference between the two. It is important to keep this in mind when assessing the character of these metal components, as well as when searching for actual sources of deterioration (photo 11).

Mechanical

The most notable hardware components associated with the mechanical system are the heating radiator covers (photo 12). They are constructed of ornate iron scroll work, accented by decorative brass medallions. The iron scroll work is finished with "Old Iron," the radiators painted tan to blend with the plaster walls.

Electrical

Lighting. Scotty's Castle was designed to be electrified, thus artificial lighting is an integral part of setting, ambience, and mood that are so important in defining the character of interior space. There are countless light fixtures varying in complexity from a single light bulb with a brass leaf socket, to the large multi-tiered chandeliers that hang in the Great Hall and Upper Music Room. Though there are literally hundreds of such fixtures, they were all individually designed and hand crafted of wood, iron, brass, and glass. They are either hung by chain or surface mounted to ceilings or walls (photos 13-29), or in some cases an integral part of the furnishings (photo 22).

One known exception to the fact that almost all hardware was designed and crafted for Scotty's Castle, are the chandeliers in the Lower Music Room. They are documented as being imported from Spain (photo 35).⁹⁵ It is important to note that the finish on these fixtures is virtually indistinguishable from others of the same type which were designed for the castle.

95. Lower Music Room Chandeliers, "imported" from Spain (MacNeilledge to E. Devlin, Jan. 1928, MSS 5, box 1, folder 6, SCRL) (Draft Historic Furnishing Plan, Linda Greene, DSC/HFC, 1988, page 176)

The three primary ways of emitting light from these fixtures is either by electrical candles, bare bulbs, or by the use of a lantern (amber glass, mica, multi-color stained glass, or in some cases no glass at all). Some areas, like the stage in the Upper Music room, are back lit by carefully placed light fixtures. Exterior (and some interior) light fixtures all tend to be configured into lanterns with multiple glass lights, some of them are leaded and stained glass (photo 29).

All fixtures are designed to be in keeping with the theme of a related space. One of the most distinctive examples is again the nautical motif of the basement Changing Room, where there is a chandelier (photo 16) and wall sconce (photo 26) that duplicate the seahorse design from the entrance door handle described previously.

Weathering and mechanical damage (broken glass or missing parts) have had the most effect on the historic character of exterior fixtures, whereas use of inappropriate bulbs (standard shaped light bulbs as opposed to candle shaped bulbs) has had the most effect on interior fixtures.

Glass. In terms of the exterior fixtures, it appears in most cases that a rippled, grainy, amber glass was probably the predominate glazing material used for light fixtures (in some cases mixed with multi-color stained glass; photo 29). There are still fixtures which have some or all of their original lantern panes (photo 27). Others, in more heavily traveled areas, have obviously had total replacement with modern glass (photo 28).

Metals. Some fixtures have lost their protective finish, and because of their location on the outside of the building, exhibit signs of rust. Though a rusted (Old Iron) appearance was sought after by the designers, excessive real rust is detrimental not only to the historic fabric, but to the visual character of these components.

One has to be very careful in assessing the character of light fixtures due to the maintenance work which has been performed on them through the years. The two overhead fixtures on the south porch of the Main House indicate this quite clearly. If they are viewed from the south, the one on the right (photo 27) appears deteriorated (rusted). The one on the left appears in much better condition (photo 28), its black finish uninterrupted by visual signs of simulated rust. In actuality, it is the fixture on the right which still retains its original "antique finish," and thus its true historic character. The one on the left has obviously been cleaned (with the best of intentions) sometime in the recent past, losing its "Old Iron" finish in the process (in addition to its original glass). More than likely all hardware had a black lacquer applied as a primer, prior to the application of the antique finish.

Switch Plates. In order to be consistent with the theme of a room, electrical switch plates were selected or individually designed and hand crafted in a similar manner as the light fixtures and door hardware. They are composed of iron which was hand tooled and hammered, then finished with the same "Old Iron" finish described earlier.

Observation Tower Lantern. At the top of the Observation Tower on the Main House is a glazed octagonal lantern. The astragals that support the roof appear to be brass or copper. The light is diffused with horizontal louvers.

Architectural

There are a number of metal items which are either functional or decorative that fall into this category. They are all important character defining features.

Stairs/Balcony Railings. The stair from the second level of the Main House to the Observation Tower is constructed with cast iron bracketed stringers, wrought iron balustrades and a hand tooled iron railing (wood treads, open risers). The finish on these metal components is consistent with other hardware, having the appearance of "Old Iron" (photo 30).

The spiral stair in the Annex Flag Tower has black iron railings and balustrades with decorative bronze sleeves at their mid point (steps and landings are concrete). There is a single, simple, straight flight (ladder) at the top of the spiral stair that is completely metal (photo 31).

There are iron railings located in the arched openings of the Observation Tower on the Main House, east and west ends of the south porch, and next to the basement stair in the courtyard. All appear to have been black lacquered except for the basement stair railing, which has some remnants of green paint (though rusted).

Decorative Screens and Crests. Examples of decorative iron screens and crests can be found in the Upper Music Room (photo 32) and screens in the Solarium (photo 33).

The Upper Music Room screen for the organ console is a composite of antique European wrought iron work and new work. The workmanship here is quite remarkable, because it is nearly impossible to distinguish older components from later ones. There are polished brass elements (busts) and enameled shields applied, which contrast sharply with the dark iron screen elements.

Located on the top of the two rounded in-fill corners of the Upper Music Room are decorative black iron crests. They are accented with antiqued brass floral elements and an array of ornate black iron finials (Photo 33).

Courtyard Gates. A combination wood and iron elements make up the fence and gate assembly which connects the Main House with the Annex. These decorative, as well as structural, iron elements are located between the rails and stiles of a heavy wood lattice. The iron work itself appears to have been treated with the "Old Iron" finish. In the center of the main gates, there is a distinctive "J/S" cast into one of the elements.

Roofing. There are two locations where metal components are used for roofing. The primary one is the gently sloping roof over the Veranda on the south elevation of the Main House, the other is the slightly domed cupola roof at the top of the Main House Observation Tower. The material used for both of these roofs appears to be copper. The roof over the Veranda has large standing seams spanning between decorative bent pipe stanchions and the Main House wall. The roof support frame is also constructed with pipes, bolted to the wall and stanchions. The octagonal cupola roof is symmetrical with flat seams.

Weather Vanes/Flag Pole. There are two prominent weather vanes constructed of hand-wrought bronze or brass. One is set at the top of the Cupola, the other at the top of the second floor Annex entrance vestibule. These are cut-out, flat silhouettes. A metal flag pole is mounted on the top of the Annex Tower.

Miscellaneous Decorative Elements. There are a number of metal items placed on the castle walls that are purely decorative in nature. They include things like the "bullet splitters," mounted just outside Scotty's room, pot holders on the south porch, the shadow bar for the sundial on the south wall of the Annex, and the bells and their carriages located on the same wing (photos 36,37,38,39).

EXISTING CONDITIONS / ANALYSIS / FINDINGS

Doors

General. The door hardware is in very good to excellent condition considering the age of the structure and the fact that very little has been done to it over the years. It is all operable, and though the dry climate of Death Valley has a great deal to do with this, it is not the only consideration. The following assessment covers all elements of door hardware including studs, handles, and surface mounted latches and strikes.

Finish Characteristics. The first thing that comes to mind is that the door hardware appears rusted, inside and out. On the exterior, there is something even more unusual about the way it is deteriorating. In locations where there is the least access to weathering, the hardware appears to be the most deteriorated, and visa versa. Upon closer inspection, as noted in the in the previous discussion under character definition, this rusted or "Old Iron" appearance was consciously planned and carefully executed by the designers and craftsmen.

Staged Finish Degeneration. The hardware actually turns a dull silver in locations where the splash-back, weathering, and natural sand blasting are the most severe. This is due in part to its composition, and also to the fact that these are locations (bottom of doors) where the hardware (usually large strap hinges) has lost most or all of its original finish. This effect of staged deterioration can plainly be seen with the three hinges in photo 40, and essentially to varying degrees on all the exterior doors. The top hinge (protected by the door head and height from the ground) still retains most of its original finish, the middle hinge (less protected) has lost its brownish color and appears black, the bottom hinge (least protected) appears dull silver with some highlights of rust (see photos 41,42 for close-ups).

Finish Chronology. One of the most unique things about this "Old Iron" finish (applied to almost all of the door hardware, interior or exterior) is that it matches the appearance of rusted iron very closely. This is particularly true in areas where the hardware finish is beginning to break down.

Based on detailed observations (staged degeneration) and what limited historic data is available, the following sequence of finishes is presented as a preamble to further research (see recommended treatment).

1. Large decorative strap (minus the hinges) arrived on site, unfinished (There is still a large quantity of unused straps in the park collection). Some appear to have been black lacquered (possibly back-primed).
2. Straps were welded to off-the-shelf "Stanley" hinges on site (there was an expert welder in residence). Additionally, hand tooling and chiseled ornamentation was probably carried out at this time.
3. Hinge assemblies were mounted on doors in a "bright" condition,⁹⁶ although this does not preclude the possibility that some were installed already primed.

⁹⁶ One instance is shown in a historic photograph in the collection, DEVA copy file No. 18385, ca. 1928, the interior side of a Great Hall door, having been hung but not having its final finishes.

4. It appears, when close-up photographs are scrutinized (photos 41, 42), that there may have been a clear finish (varnish, shellac, or lacquer) applied to the metal prior to the black lacquer. This may have been to facilitate hand rubbing in order to show the contrasting highlights of bright metal (beginning of the "Old Iron" look).

5. The finished appearance of the exterior door hardware appears to have had an application of semi-transparent (lightly pigmented varnish, linseed oil, or lacquer). This final treatment gave the hardware its distinctive antique, or "Old Iron" appearance.

6. Interior hardware had one or more additional finish applications, as alluded to earlier, to be in keeping with the theme or motif of a given interior space. This was accomplished by an extremely subtle touch of color that would find its way into the trace work and hand chiseling. In some cases this final treatment may have been an overall toning down of the glossy finish to make the piece appear dull and rusted, again as appropriate for the given room.

Substrate Characteristics. Other contributing aspects of this unusual finish deterioration have to do with the composition of the metal itself. In addition to its seemingly high resistance to rust, the metal used for strap hinges and handles retains an unusually "bright" appearance when the finish is either weathered off or polished by use. If a magnet is applied, there are varying degrees of attraction detectable, but certainly not as much as pure cast iron pieces. In fact, on certain elements (like the seahorse door handle), there is virtually no discernable magnetic attraction. The metal appears to have a high nickel content (low iron), though this is purely conjecture at this point.

Windows

General. The manufactured windows are one of the more straight forward and consistently detailed aspects of Scotty's Castle. As mentioned earlier under character definition, they have changed little since their initial installation. They are manufactured metal casement sash and frame, with multiple, single, and fixed light configurations. Their condition varies greatly depending on where they are located on the structure. Windows on the Annex wing first floor tend to be in poor condition because of the problems associated with the stucco failure (see stucco chapter). All of the windows, with the exception of the second floor interior clerestory and leaded glass windows in the Upper Music Room, are suffering from varying degrees of paint failure. Appropriate glazing repair is also a problem in isolated incidences.

Finish Characteristics. There appears to be no doubt the windows were painted historically, and little has been done to them (other than glazing repair) since. When all of the windows are surveyed and compared, there is one color that seems to predominate; an olive drab. The amount of weathering and sun a particular window receives on a regular basis seems to affect this color and turn it more orange or rusted looking. In the case of windows, it does not appear the color was deliberately chosen to look like "Old Iron." And unlike the door hardware, the steel frames are susceptible to rusting when they have lost their protective paint finish.

Staged Finish Degeneration. The windows exhibit a full range of finish conditions, from the totally protected (second floor clerestories) to near catastrophic failure of finish (south wall of annex). There is evidence of a dark primer on some of the exterior windows where the paint has been partially removed by the elements. Interior windows have evidence of both light and dark primers where the paint has either been worn away or chalked off. However, the finish color appears to be the consistent olive drab color, inside or out.

Later replacement glass is quite easy to locate because its white glazing compound (unpainted) starkly contrasts with the dull weathered appearance of the original.

Finish Chronology. Based on what is visible due to the staged deterioration, it seems all of the metal windows were primed and painted only once.

Substrate Characteristics. All window components appear to be made of ferrous metal, probably steel (with the exception of leaded glass in the Upper Music Room).

Fireplaces

General. The various hardware components associated with fireplaces are constructed and embellished in much the same manner as door hardware and lighting fixtures. As with other applications throughout the castle, the iron screens, decorative grills, andirons, and hoods are highly stylized to be in keeping with a particular room's motif (photo 10).

Finish Characteristics. Most of the fireplace hardware is finished in the previously described "Old Iron" appearance, with accents of polished bronze or vice versa. The bronze (sometimes copper) elements probably have a clear (varnish or lacquer) finish on them to keep them from tarnishing.

Staged Finish Degeneration. All fireplace hardware is interior, so there has been no staged degeneration from weathering. Generally speaking, fireplaces do not appear to have been used that much, except for the one in the Great Hall, thus there is little or no degeneration of finishes from use.

Finish Chronology. (See door hardware.)

Substrate Characteristics. There is generally a hand-wrought appearance to most surfaces that was either achieved through the casting or actual hand tooling of the pieces. Again, this varies from piece to piece, similar to the door hardware and light fixtures.

Structural

General. There is a considerable amount of exposed hardware dedicated to structural applications. It is treated with the same level of detail and finish as other hardware items, blending with particular motifs, and being most visible in the larger spaces, like the Great Hall and Upper Music Room. The condition of these elements tends to be excellent.

In the Great Hall, there have been later structural stabilizing measures resulting in new elements which lack the style and finish of original work. They are easily distinguished from the earlier items (painted beige), and are not described in the following analysis (photo 11).

Finish Characteristics. Most structural hardware tends to have a dull finish (Old Iron), similar to light fixtures. It appears these gussets, rods, and bolts may not have been given additional clear coats like the door hardware. On structural hardware, the "Old Iron" finish appears very much like rust.

Staged Finish Degeneration. Most exposed structural hardware is interior (with the exception of decorative south porch roof supports) and thus is not degenerating due to weather. Instead, it is generally located in hard to reach areas, like ceilings, and is not easily cleaned.

The decorative bent pipe supports on the south porch demonstrate a combination of "Old Iron" finish and actual rust. They appear totally rusted, but as previously discussed the two effects can be virtually indistinguishable. The rust tends to have a vertical grain to it where moisture has cascaded over the surface. The "Old Iron" appears more hand applied, splotchy (photo 43).

Finish Chronology. The finish chronology appears to be similar to door hardware without several of the possibly later layers of clear finish. (This could account for the dull appearance.) In locations where the wood is stained, it appears that the hardware also received an additional treatment (application of stain) to match the appearance of the room.

Substrate Characteristics. The actual metal used in structural applications (excluding modern work) is probably iron or mild steel depending on its use.

Mechanical

General. The most visible hardware, related to mechanical systems, are the radiator grills. They appear to be in excellent condition.

Finish Characteristics. The primary finish is "Old Iron," similar to what is found throughout the interior. Polished brass or bronze decorative elements contrast with the dull appearance of the primary old iron finish of the gratings (photo 12).

Staged Finish Degeneration. None apparent.

Finish Chronology. Similar to chronology for light fixtures.

Substrate Characteristics. The substrate appears to be hand tooled or wrought iron, with decorative bronze or brass figures placed in the scrollwork of the design.

Electrical

General. The visible electrical hardware consists almost entirely of light fixtures (interior and exterior) and switch plates. Items located in the interior are in excellent condition, those on the exterior do show some signs of deterioration from weathering and replacement of historic glass.

The light fixtures are, without doubt, the most complex of all hardware items, yet are the most visible night or day. They are all individually designed and hand crafted with extreme attention to detail, providing all or most of the required artificial light for the building.

In at least one case (Lower Music Room) the fixtures were imported from Spain, as mentioned earlier under character definition. However, it is likely they were reworked by the craftsmen on site, because they so closely match the finish appearance of those fabricated locally.

Finish Characteristics. Being the strong design element they are, interior light fixtures and switch plates are displayed prominently. They, like the interior door hardware, pick up the

various finish themes of rooms they are placed in by having color subtly wiped on the surface, and or polished brass and enamel accents. Yet the base for this thematic touch is invariably the "Old Iron" finish (usually a dull and colorless old iron appearance). There is considerable variation within the bounds of this basic composition. Some of the hardware is finished plainly with little or no embellishment (appearing rusted), other examples exhibit definite dashes of color, interwoven leaves and scrolls of polished brass (photos 13,15).

The finish used on the metal surfaces of exterior fixtures is consistently "Old Iron." Here, as with other exterior hardware applications, the intended old patina finish is intermingled with real patina, actual corrosion. Where the weathering is the most severe, brass components of some of the fixtures have a tarnished green appearance.

Staged Finish Degeneration. As discussed in the character definition discussion, exterior light fixtures may be one of the best examples of the "Old Iron" finish being removed on one item and not another (photos 27, 28). This reveals the black lacquer finish that probably underlies most of the antique (rusty looking) finishes.

Finish Chronology. In general, the sequence of finishes appears to be similar to that used on door hardware, respective to interior and exterior locations. The difference being the quality of the substrate (door hardware having high nickel content).

Substrate Characteristics. The primary substrate for all light fixtures appears to be iron and tin; a secondary substrate being the accents of brass and copper.

The amber colored glass, or in some cases stained glass, or mica are also essential components. Other types of obscure, uncolored glass likely indicate where replacements have been made with non-historic material.

Architectural

General. The following miscellaneous hardware components are similar, in substrate and finish, to the interior and exterior hardware components previously analyzed.

Stair Assemblies, Stair/Balcony Railings, Decorative Screens and Crests, Courtyard Gates, Bullet Splitters, etc.

Exceptions are the south porch roofing, cupola roof, weather vanes and sundial shadow bar. These items are constructed with non-ferrous metal, brass or bronze. It appears they never had finishes applied historically.

Characteristics. See other discussions for hardware of similar finish and substrate.

South Porch Roof. It appears this standing seam copper roof has leaked in the past, and is possibly still leaking, because evidenced by the corrosion present on steel elements (steel pipe framing) not exposed directly to the weather. This has resulted in poor connections between roof rafters and sheathing (reference structural chapter). A detailed destructive investigation (which is beyond the scope of this report) will be required to further assess the condition of the historic roofing.

RECOMMENDED ALTERNATIVES FOR TREATMENT

Prior to any treatment considerations, it is essential that a specialist experienced with metals and hardware finishing techniques, be consulted in order to provide a comprehensive analysis of these highly significant hardware features. A scientific description/analysis of both finish color/composition and substrate will be required.

The following recommendations are only preliminary in nature (based on visual inspection only) and are subject to change, based on the in-depth analysis and findings of a specialist.

Doors

Primary recommendations for door hardware will involve components mounted on exterior surfaces, thus exposed to the elements. These items are endangered due to the loss of their protective (sacrificial) finish, exposing the substrate to continued deterioration.

General Steps Toward Recommended Treatment. These steps are recommended for use as a general outline and should allow the flexibility for experimentation and adaptation in achieving the historic appearance (also assuming that a specialist has already been consulted). A comparative example taken from a protected area should be used for comparison at all times.

1. It is recommended that all exterior hardware be inspected and inventoried to determine the extent of deterioration. Once this is accomplished, treatment can be prioritized. The following findings can be used to make these determinations:
 - a. Metal appears "dull silver" or rusted.
 - b. Metal shows black in locations where this is not the historic appearance, but merely the black primer exposed by weathering.
 - c. Paint finish is chalking, discolored.
 - d. Connections are loose, components worn.
2. If possible, it is recommended that all hardware to be treated be carefully removed from the door. If this is not possible, the door will have to be totally protected in some manner during the finish removal process.
3. It is recommended that old finish and corrosion be carefully removed from the hardware by experimenting with the gentlest means first (chemical), moving toward progressively more aggressive treatment (walnut shells/sand) until a condition of bright metal is achieved.
4. It is recommended the bright metal be treated with a clear lacquer (or by whatever finish process is recommended by specialist) immediately after bright metal has been exposed to preclude any possibility of moisture contamination (which could affect adhesion properties of the finish).
5. It is recommended that black lacquer be applied by hand (or by whatever finish process is recommended by specialist), lightly wiping it off to expose highlights of hammer markings on the metal surface.

6. It is recommended that pigmented varnish (or whatever finish is recommended by specialist) be applied over the black lacquer after it has dried. The color and appearance of the treated hardware should match the untreated historic example as closely as possible.

Alternative Treatments. No Treatment (not recommended).

Continued Maintenance (recommended)

Windows

All recommendations take into consideration that a professional paint analysis will be required to find the appropriate Munsell color codes. Additionally, some windows located in the Annex portion will have to be reset after the walls are repaired, as a part of stabilizing the stucco walls (see stucco chapter).

Manufactured Window Sash and Frames.

General Steps Toward Recommended Treatments. It is recommended that all windows be inspected and inventoried to determine the extent of deterioration.⁹⁷ Once this is accomplished, window treatment can be prioritized. The following findings can be used to make these determinations:

1. Loss of structural integrity, window components misshapen, warped; damage is such that glazing or weather tightness cannot be reestablished, window frames loose from the wall.
2. Loss of paint finish, bare metal exposed, surfaces corroding, rusting.
3. Loss of glazing compound, paint chalking.

It is recommended that frames remain in place during treatment, with extreme caution taken to protect stucco finishes and historic glass. Old finish, historic glass/glazing compound and rust should then be carefully removed from the frames, sash, and muntins by experimenting with the gentlest means first (heat/mechanical for glazing, chemical for metal), moving toward progressively more aggressive treatment (walnut shells/sand) until a condition of bright metal is achieved.

It is recommended bright metal be treated with a designated primer (as specified after paint analysis) immediately after bright metal has been exposed to preclude any possibility of moisture contamination (which could affect adhesion properties of the finish). Primer must be applied prior to reglazing.

It is recommended that window sash be re-glazed by back puttying with new glazing compound, reusing historic glass at all times where possible.

97. Reference Preservation Brief 13, *The Repair and Thermal Upgrading of Historic Steel Windows*, by Sharon C. Park, A.I.A., Technical Preservation Services, Preservation Assistance Division, National Park Service, U.S. Department of Interior.

It is recommended that window, sash, and frames be painted (as specified after paint analysis) to match the designated Munsell color. Paint should cover glazing compound and 1/16th of an inch of glass. Extreme care must be exercised to protect surrounding stucco and wood surfaces.

Alternative Treatments. No Treatment (not recommended).

Continued Maintenance (recommended).

Window Grills.

General Steps Toward Recommended Treatment. It is recommended that all exterior window grills be inspected and inventoried to determine the extent of deterioration. Once this is accomplished, treatment can be prioritized. The following findings can be used to make these determinations:

1. Metal is corroded or rusted.
2. Metal shows black in locations where this is not the historic appearance, but merely the black primer exposed by weathering.
3. Paint finish is chalking, discolored, or missing.
4. Connections are loose where they are mounted on the walls.

If possible, it is recommended that grills to be treated remain on the building. Window sash, frames, and the building itself, should be totally protected in some manner during the finish removal process.

It is recommended that old finish and corrosion be carefully removed from the grills by experimenting with the gentlest means first (chemical), moving toward progressively more aggressive treatment (walnut shells/sand) until a condition of bright metal is achieved.

It is recommended the bright metal be treated with a high quality metal primer immediately after bright metal has been exposed to preclude any possibility of moisture contamination (which could affect adhesion properties of the finish).

It is recommended that paint of the appropriate color (or whatever finish is recommended by specialist) be applied over the primer after it has dried.

Alternative Treatments. No Treatment (not recommended).

Continued Maintenance (recommended).

Shutter Hardware.

General Steps Toward Recommended Treatment. (See door hardware.)

Structural

It is recommended that roof supports for the south porch (reference structural chapter) be inspected for corrosion and general finish deterioration. Treatment for the five decorative pipe columns must be carried out in concert with any required structural stabilization.

General Steps Toward Recommended Treatment. It is recommended that all decorative pipe columns be carefully taken down to bright metal (similar to recommended door hardware treatment) and painted according to recommendations set forth as the result of paint analysis.

Alternative Treatments. None.

Electrical

It is recommended that all exterior light fixtures be closely inspected and treated if required. An example of each type of fixture finish should be identified on the building for later use as a comparative sample when matching historic appearance.

General Steps Toward Recommended Treatment. It is recommended that all exterior light fixtures be inspected and inventoried to determine the extent of deterioration. Once this is accomplished, treatment can be prioritized. The following findings can be used to make these determinations:

1. Metal components appear corroded or rusted.
2. Lantern glass appears to be inappropriate replacement (i.e. white glass instead of grained amber).
3. Metal shows black in locations where this is not the historic appearance, but merely the black primer exposed by weathering.
4. Paint finish is chalking, discolored.
5. Connections or components are loose, or missing.

If possible, it is recommended that all fixtures to be treated be carefully removed from the building. If this is not possible, the surrounding walls will have to be totally protected in some manner during the finish removal process.

It is recommended that all historic lantern glass be removed and salvaged.

It is recommended that old finish and rust be carefully removed from the fixture by experimenting with the gentlest means first (chemical), moving toward progressively more aggressive treatment (walnut shells/sand) until a condition of bright metal is achieved.

It is recommended that bright metal be treated with a clear lacquer (or by whatever finish process is recommended by specialist), immediately after bright metal has been exposed to preclude any possibility of moisture contamination (which could affect adhesion properties of the finish).

It is recommended that any missing elements be fabricated and restored to light fixtures as required.

Apply black lacquer by hand (or by whatever finish process is recommended by specialist), lightly wiping it off to expose highlights of hammer markings on the metal surface.

It is recommended that the "Old Iron" finish of pigmented varnish be applied on fixtures where this finish is deemed appropriate (following recommendations set forth in the paint analysis) for color and composition.

Alternative Treatments. No Treatment (not recommended).

General maintenance cleaning of Light Fixtures (recommended).

Replacement of inappropriate (non-historic) lantern glass with grained amber (recommended).

Architectural

There are a number of architectural items which will require further or destructive investigation as time warrants. They are either considered long range, or related to other disciplines.

General Steps Toward Recommended Treatment.

Veranda Roof. It is recommended that when the south porch roof is investigated for structural integrity, that it also be inspected for evidence of leaks. If at that time it is deemed necessary, treatment recommendations must then be developed in concert with a structural engineer (see structural chapter).

Tower Ladder. It is recommended the ladder stair to the observation deck of the Annex Flag Tower have all corrosion removed down to bright metal, and "Old Iron" finish applied. Similarly, the upper portion of the stair to the observation tower on the Main House should be closely inspected and treated in the same manner, if it appears there is significant deterioration from past (swamp cooler) leaks.

"No treatment" is not recommended.

Tower Railings. It is recommended that balcony railings on the Observation Tower of the Main House be inspected for secureness (see structural and stucco chapters for recommended treatments).

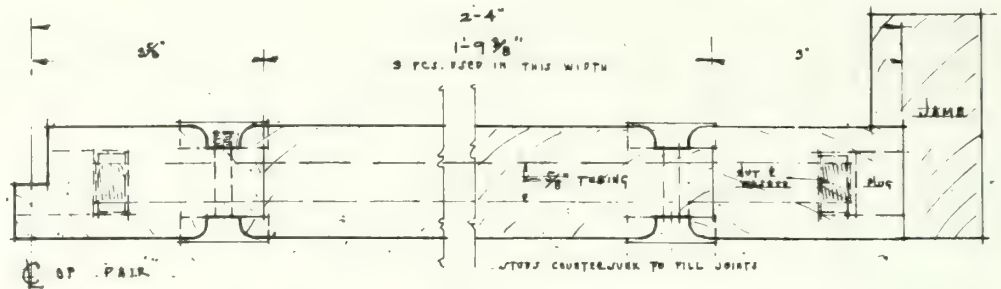
"No treatment" is not recommended.

Exterior Stair Railings. It is recommended that exterior stair railings be evaluated and treated in the same manner as exterior window grills. Similar to exterior window grills, remnants of paint are present which will require analysis by a conservator in order to match the historic color.

"No treatment" is not recommended.

RECOMMENDATIONS FOR FURTHER STUDY

It is recommended that a comprehensive conservation analysis be programmed for, and utilized, to supply the much needed data for accurately reproducing hardware finish and composition.

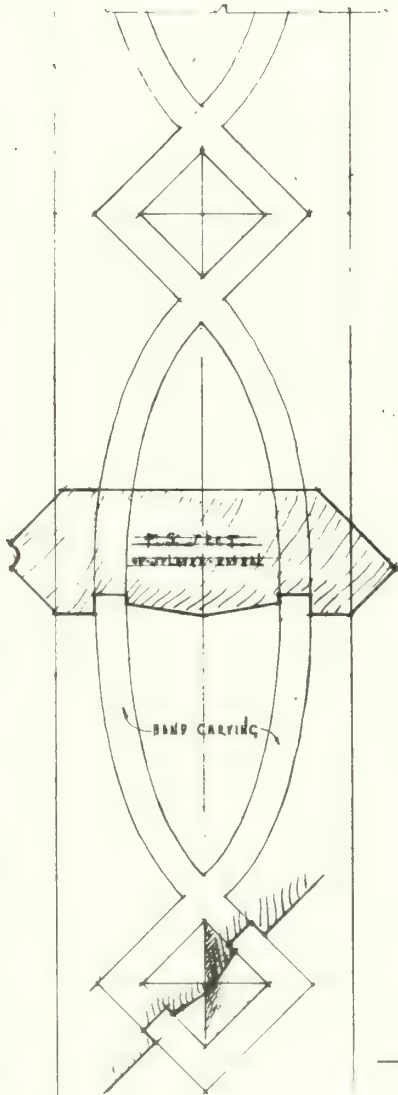


- FULL SIZE PLAN OF DOOR & JAMB -



THREE CARVING
MAKES THREE CUTS TO RECEIVE
/ CARRIED DRIVE

FACE OF STUD

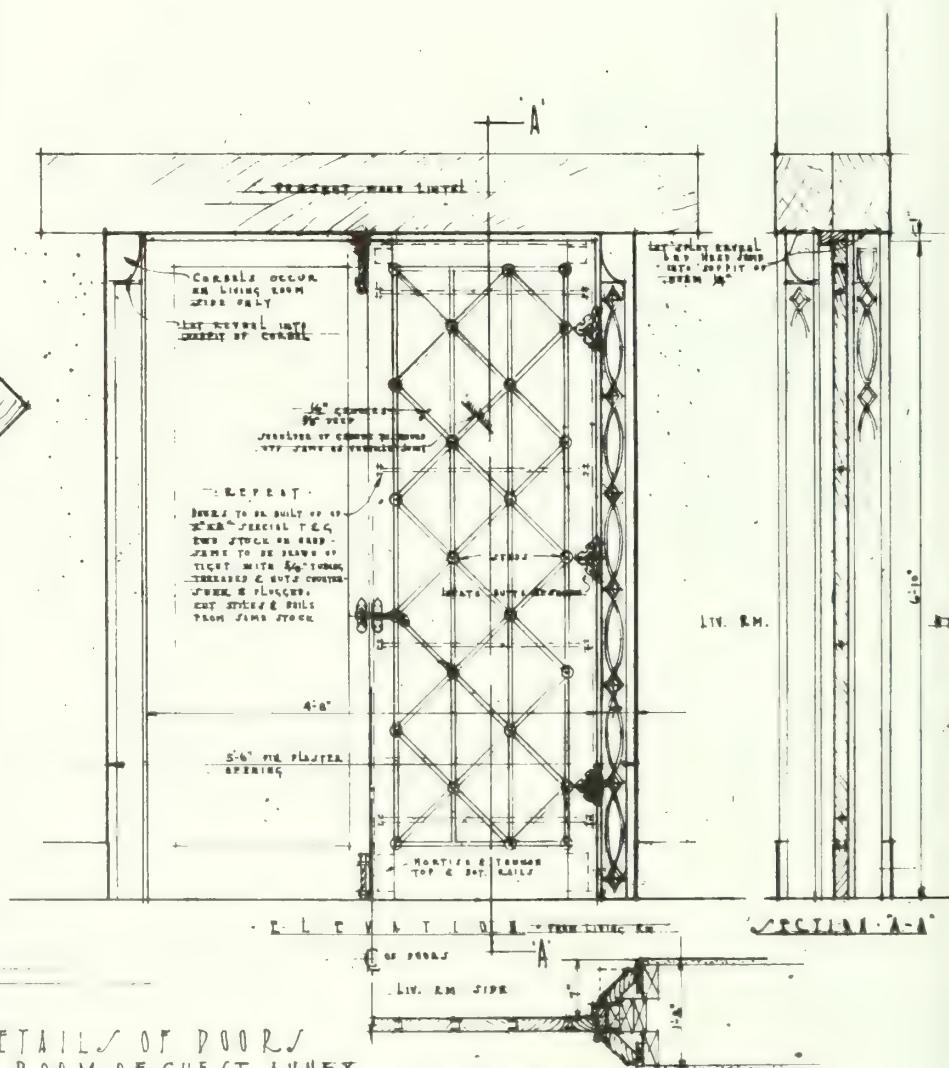
FULL SIZE PART ELEV.
OF CARVED REVEAL

1 1/2" SCALE & F.S. DETAILS OF DOORS
BET. HALL & LIVING ROOM OF GUEST ANNEX

DEATH VALLEY RANCH

JOHNSON & SCOTT

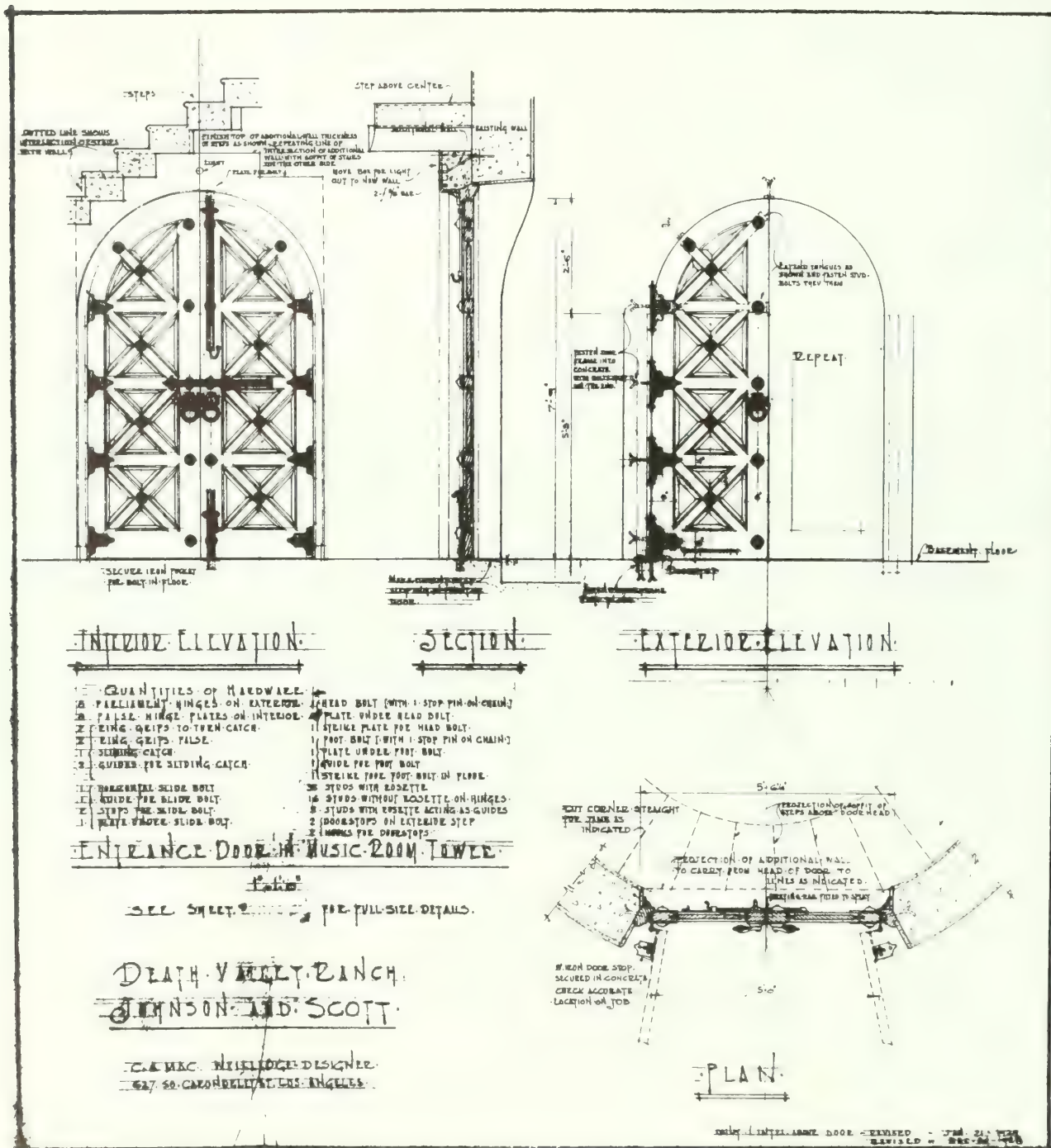
C. A. MACBILLEDGE - DESIGNER



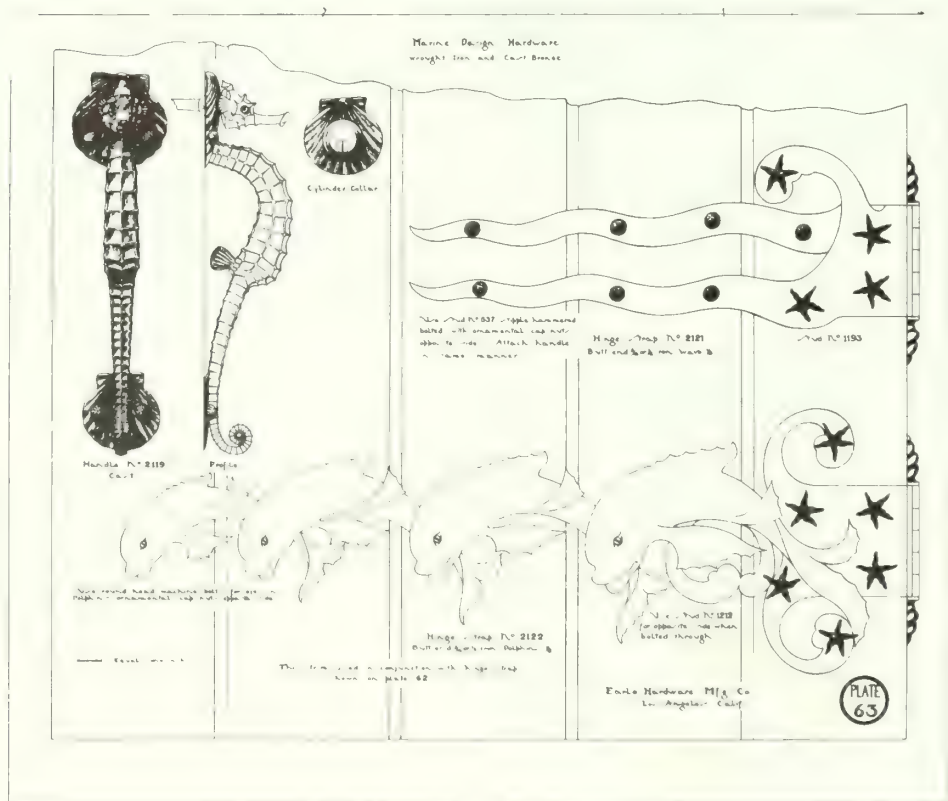
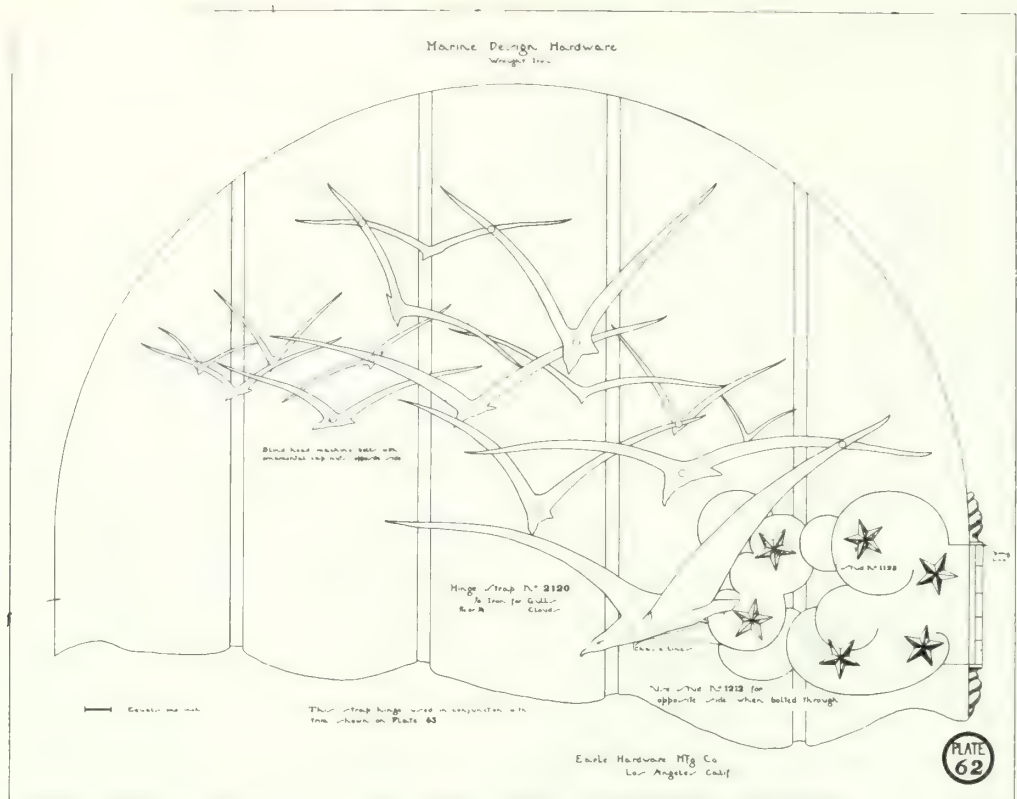
Historic Drawing 1: Doors Between Hall and Living Room of Guest Annex



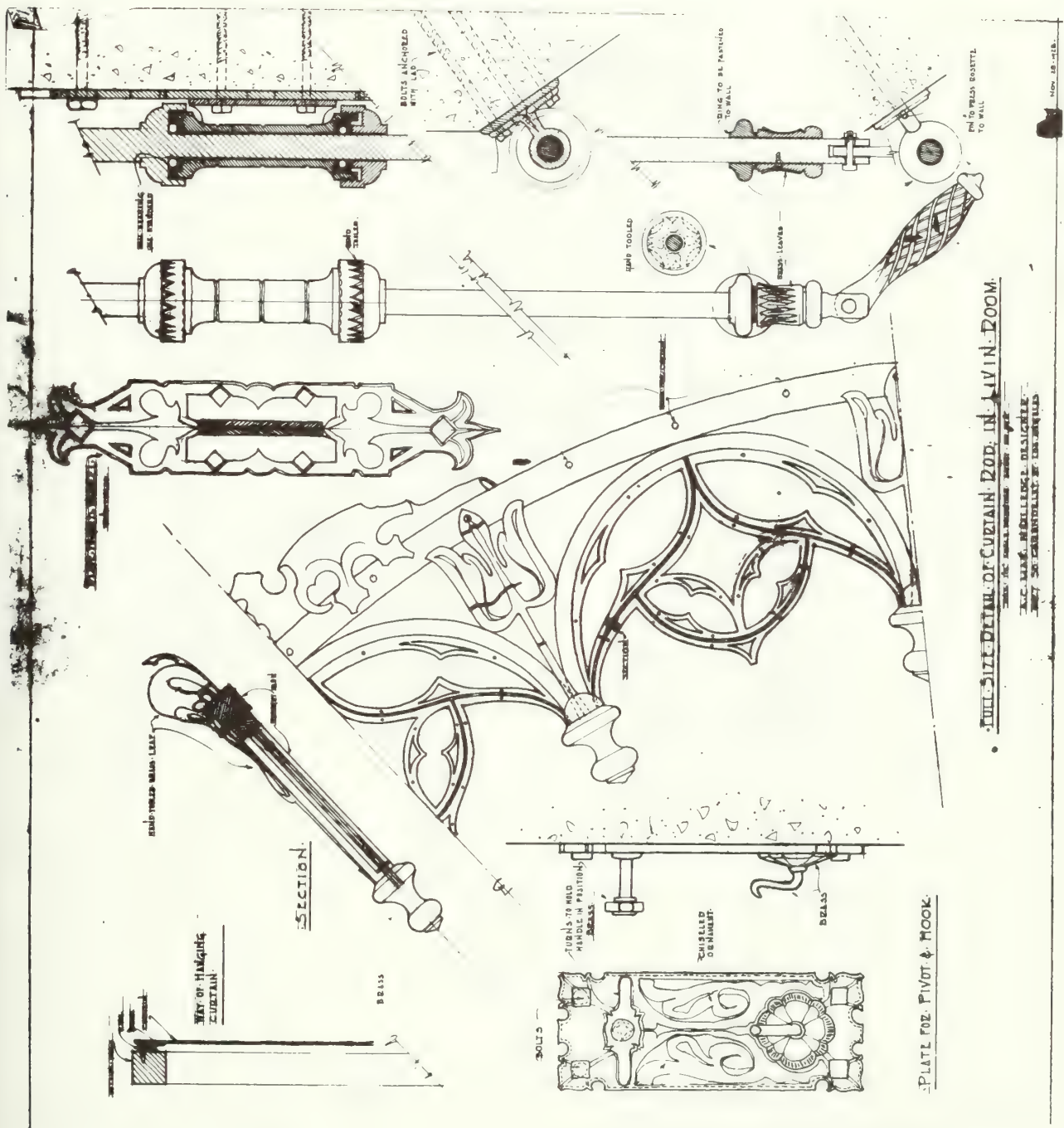
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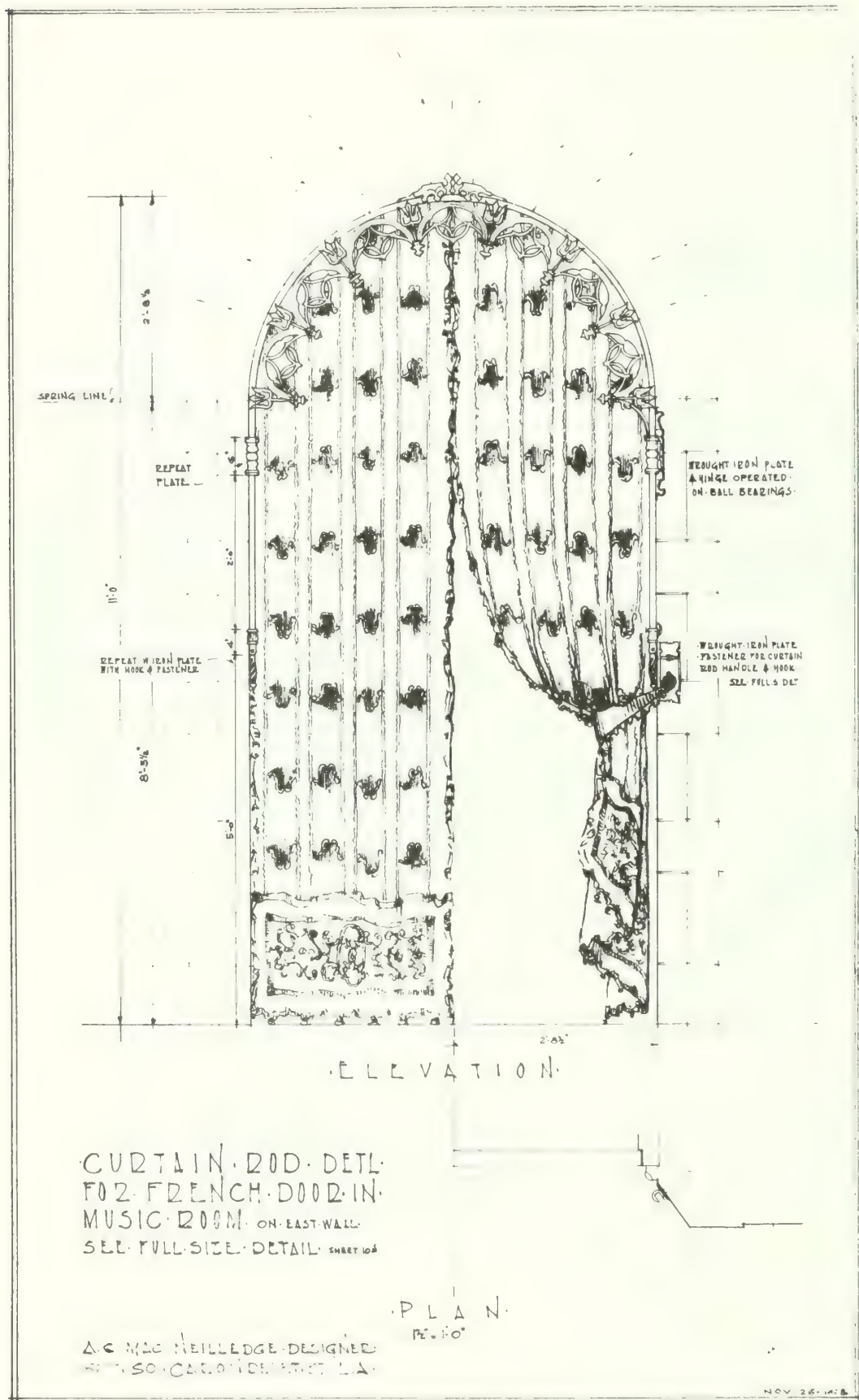
Historic Drawing 3: Entrance Door in Music Room Tower



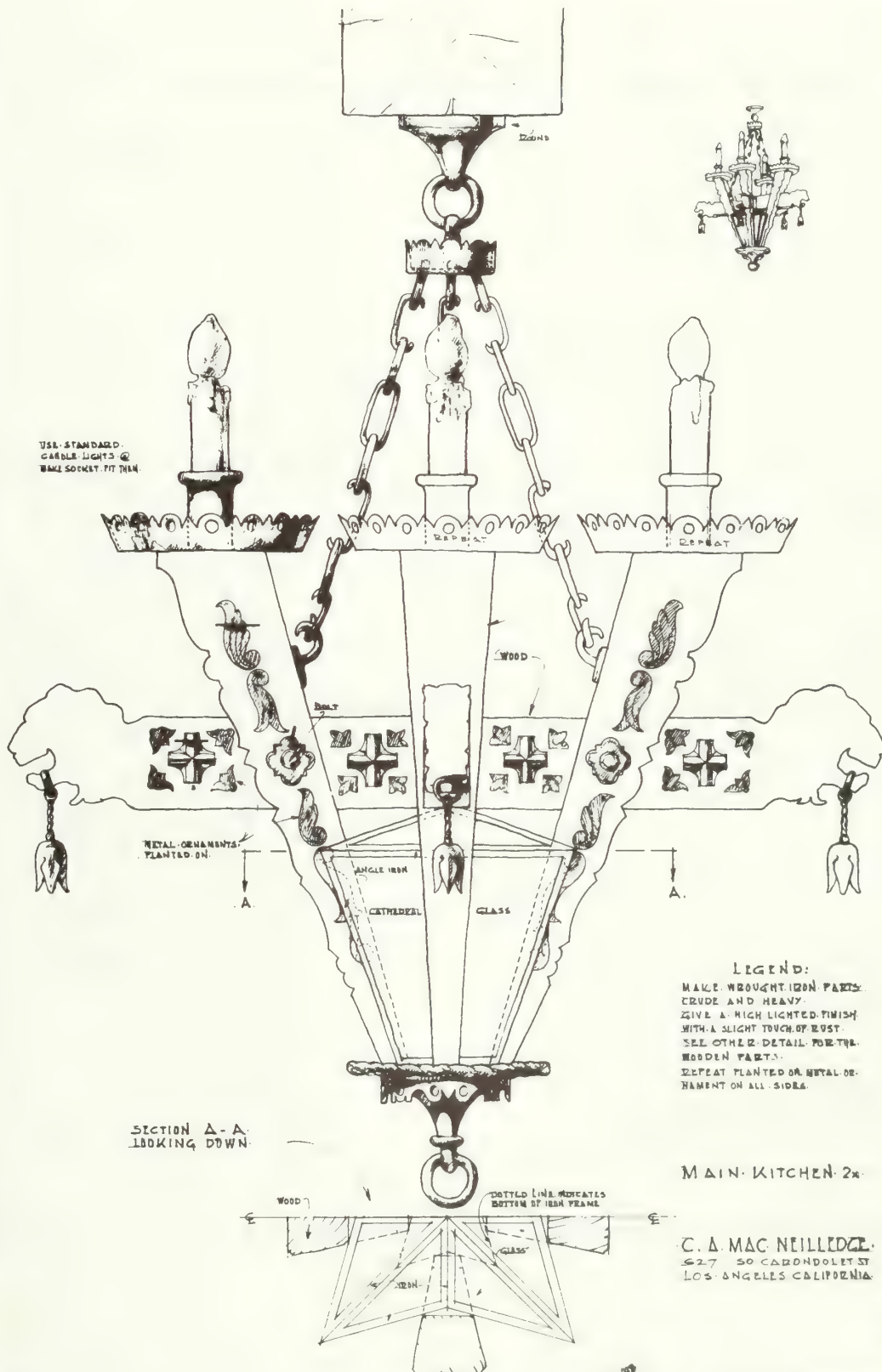
Historic Drawing 5: Marine Design Hardware



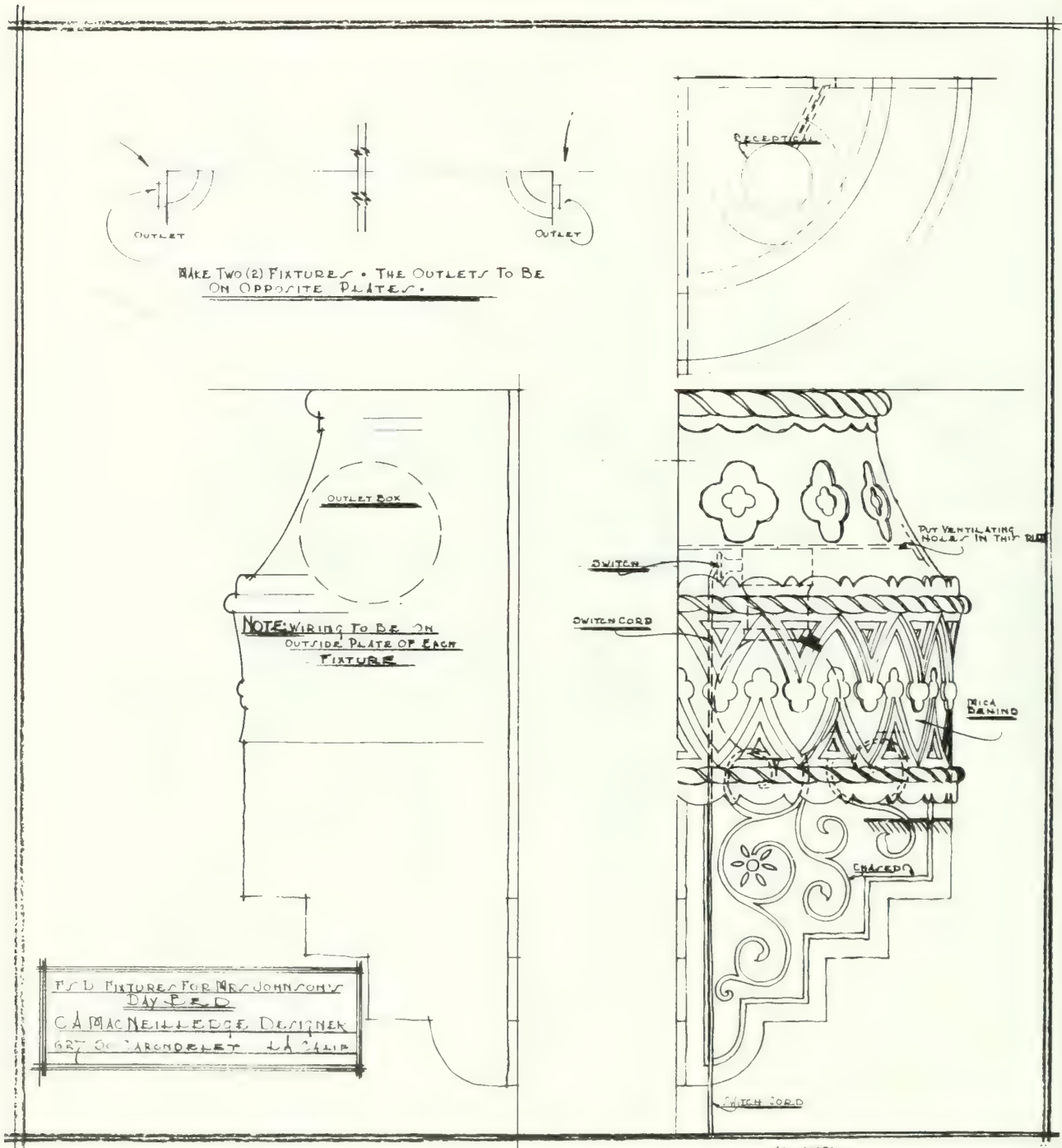
Historic Drawing 6: Curtain Rod Detail in Living Room



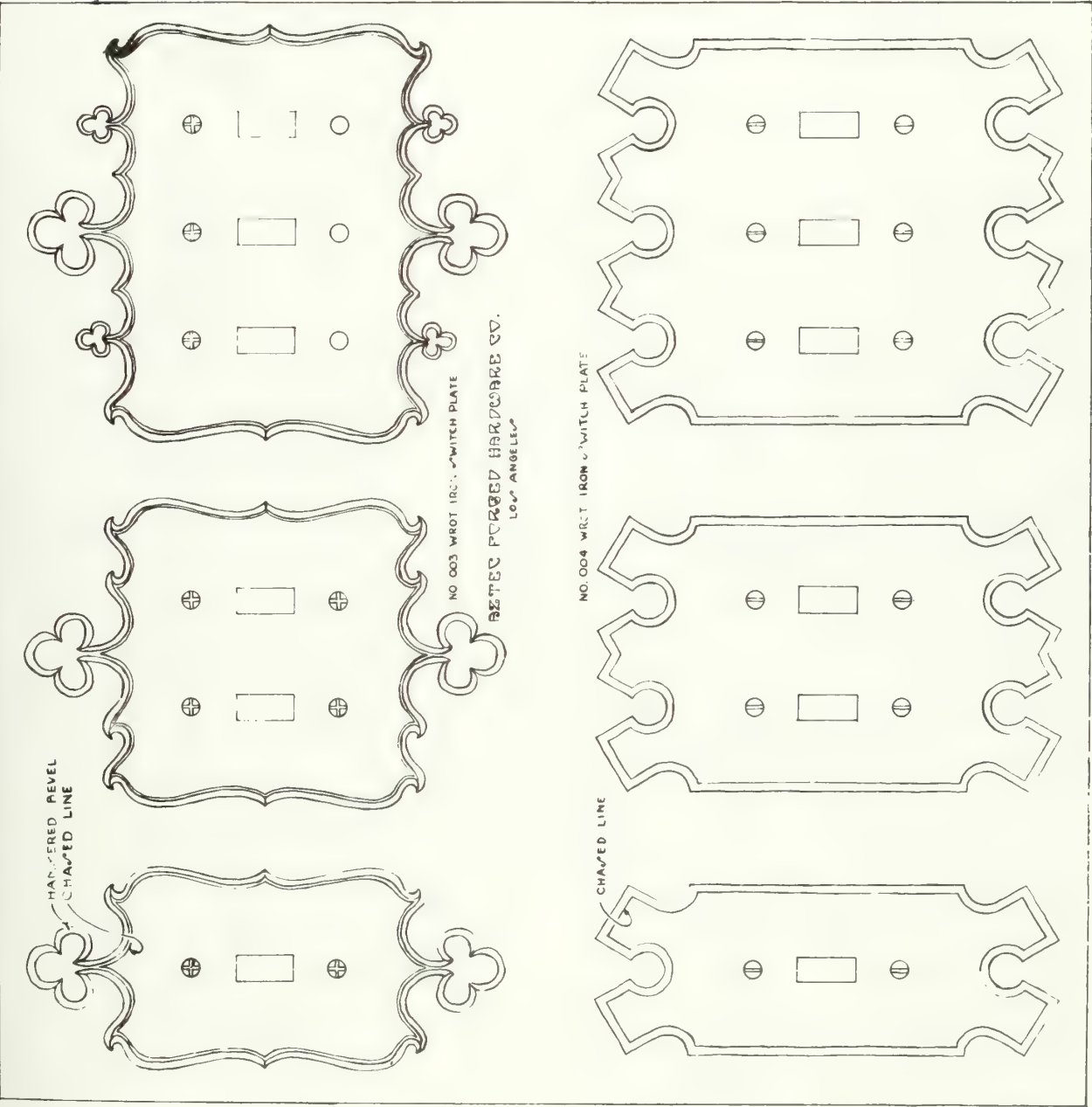
Historic Drawing 7: Curtain Rod Detail for French Door in Music Room



Historic Drawing 8: Light Fixture in Main Kitchen

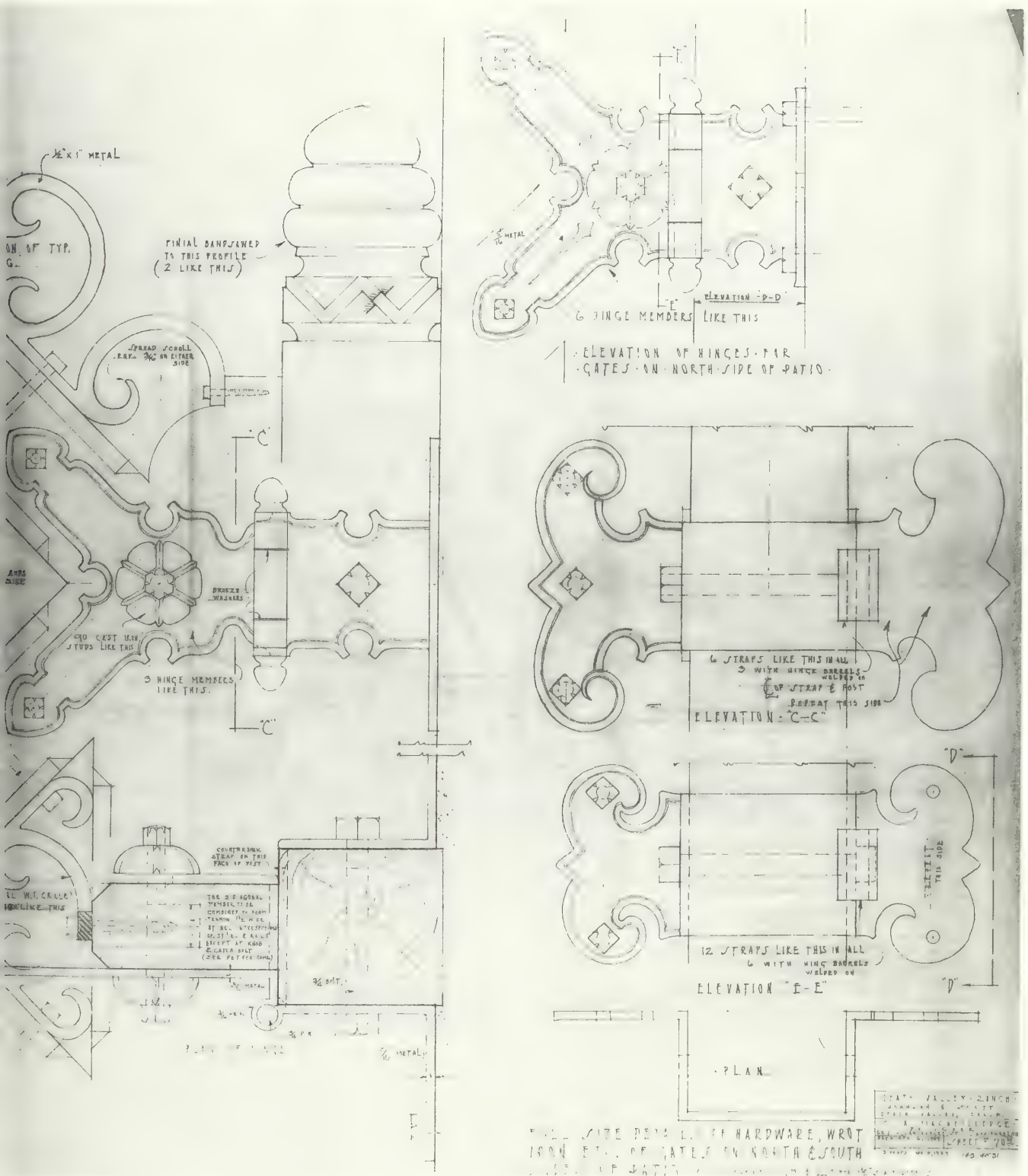


Historic Drawing 9: Fixtures for Mrs. Johnson's Day Bed

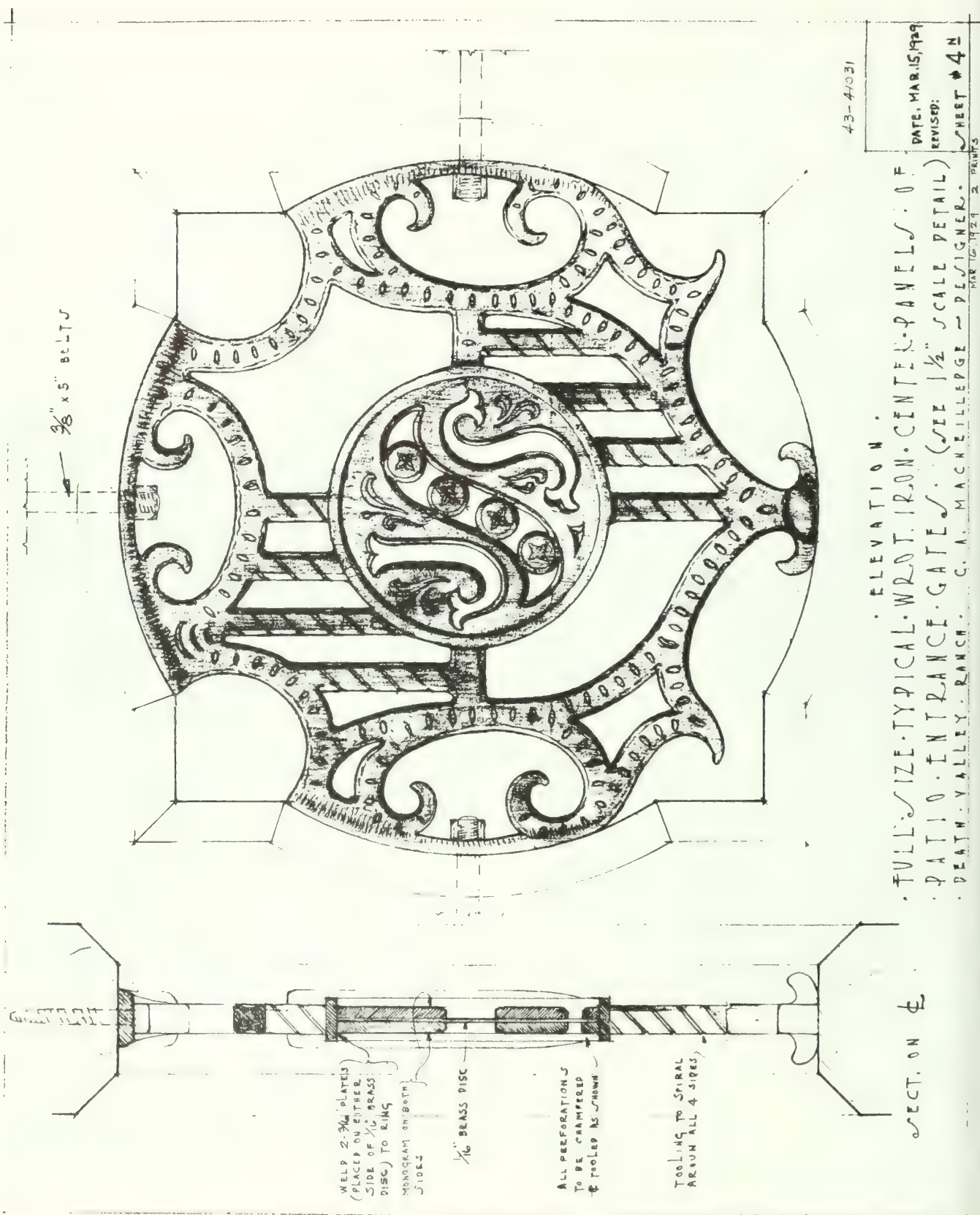


Historic Drawing 10: Switch Plates





Historic Drawing 12: Hardware Details, Gates on North and South Sides of Patio



Historic Drawing 13: Center Panels of Patio Entrance Gates



Photo 1: Door from stair vestibule to Kitchen. Note paired studs and elaborate surface locks.



Photo 2: Seahorse pull handle. On entry door to Changing Room, Main House Basement.



Photo 3: Exterior of door to the Changing Room. Note progressive deterioration of decorative strap hinges, from top to bottom.

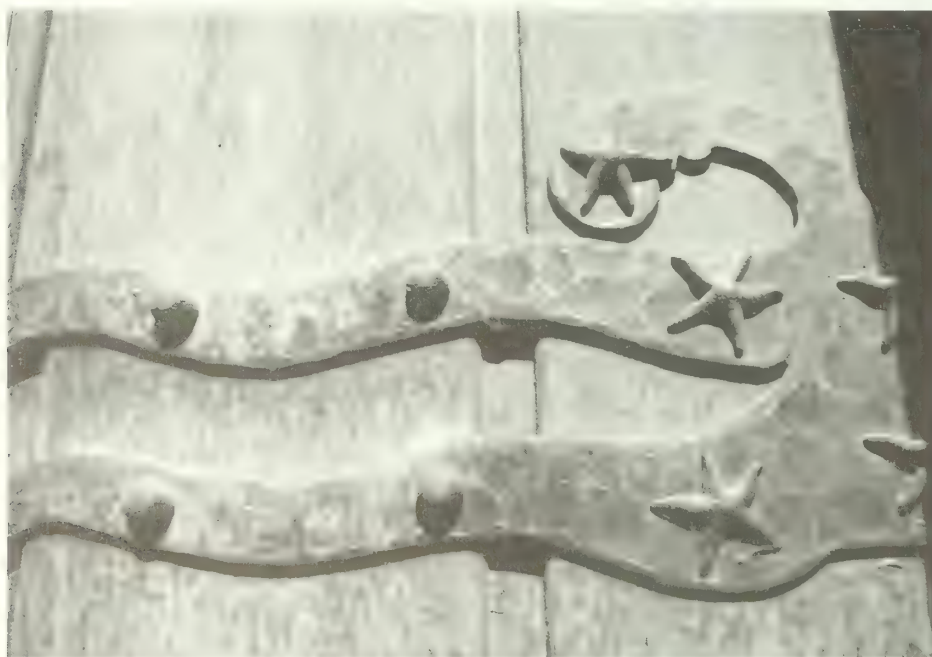


Photo 4: Middle strap hinge. Door to Changing Room.

Photo 5: Main door into Great Hall. Strap and Stanley hinges.



Photo 6: Hinge, main entry door, north wall, Great Hall.



Photo 7: Multi-light casement window.



Photo 8: Exterior basement window grating.

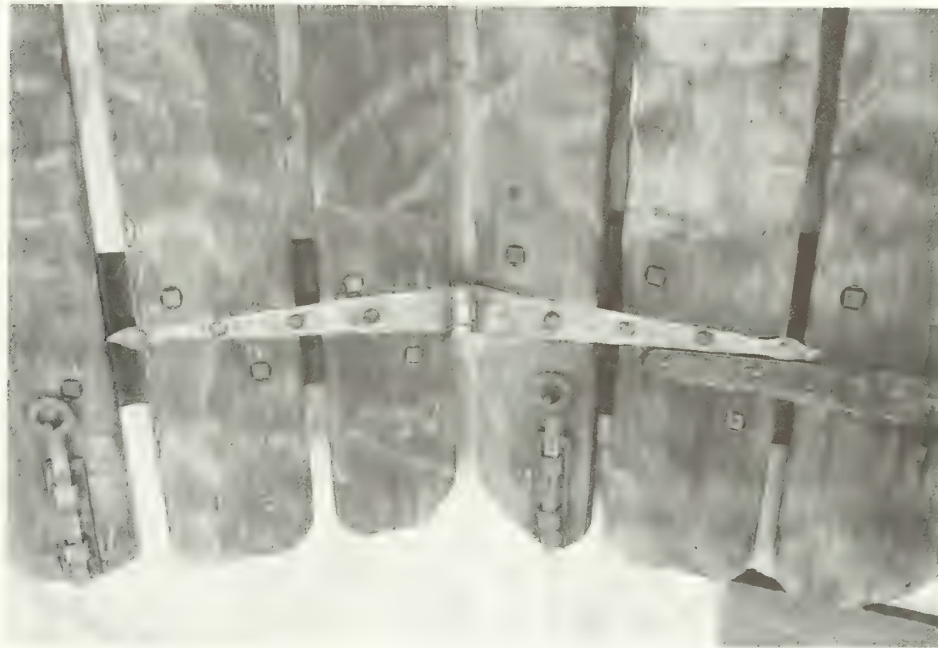


Photo 9: Typical strap hinges on shutter. Note the difference in craftsmanship and rate of corrosion.



Photo 10: Fireplace in Great Hall.



Photo 11: Great Hall truss. Decorative iron gusset and modern steel rod. Monitoring instrument to the left.



Photo 12: Decorative radiator grating.



Photo 13: Chandelier in Upper Music Room. Note enameled shields.



Photo 14: Back-lighting behind valance, Upper Music Room stage.



Photo 15: Chandelier in Great Hall.



Photo 16: Chandelier in Changing Room. Note use of seahorse shape.



Photo 17: Example of chandelier. Using amber glass lantern, decorative iron, and chains.



Photo 18: Example of flush mounted light fixture. Lantern appears to have been set with mica.



Photo 19: Example of flush mounted light fixture. Located in bathroom, decoratively painted iron.



Photo 20: Typical closet light fixture. Note brass leaves.

Photo 21: Wall sconce. Located in Great Hall. Note how finish accents tooling.



Photo 22: Example of light fixture. Designed as an integral element of furnishings. Mrs. Johnson's bedroom.



Photo 23: Example of sconce in Tower.



Photo 24: Example of flush mounted fixture. Mica lantern in Dining Room of the Main House.



Photo 25: Example of hand painted sconce. Located in one of the bathrooms. This fixture appears to have a very authentic patina of tarnished copper, with an accent of polished brass.



Photo 26: Seahorse sconce. Thematically consistent with other hardware details in the basement Changing Room (see photo 16). Note inappropriate light bulbs used to increase light level.

Photo 27: Exterior light fixture. Located under the south porch. Note original "Old Iron" finish and partial replacement of lantern glass.



Photo 28: South porch light fixture. Companion to the one illustrated in photo 27. Note loss of "Old Iron" finish and total replacement of lantern glass.



Photo 29: Exterior light fixture. Located in entry vestibule of Annex second floor foyer. Note stained and leaded glass used in the lantern.



Photo 30: Decorative iron stair stringer and balustrades. Leading up to the Observation Tower of the Main House. Note wiped on "Old Iron" finish.



Photo 31: Stair. Leads to top of main tower at the Annex. Note actual corrosion from weather exposure on stringers and treads.



Photo 32: Decorative iron crest. Located in Upper Music Room. Note accent with polished brass.

Photo 33: Decorative iron gate in Solarium. There is extensive use of color on this piece, consistent with the theme of the room.



Photo 34: Decorative iron curtain rod bracket. Located in the main hall. Note "Old Iron" finish on bracket and insect screen storage.



Photo 35: Imported Spanish chandeliers. Located in Lower Music Room.



Photo 36: Bell. Located at the east end of the second floor Annex.



Photo 37: Iron bullet or shot splitter. Located on the exterior of the Main House, outside Scotty's Room.



Photo 38: Weather vane. Located on top of the second floor entrance vestibule.

Photo 39: Small bell. Located outside Mrs. Johnson's Apartment.



Photo 40: Typical exterior door. Located on first floor of the Main House, illustrating the "staged finish degeneration."



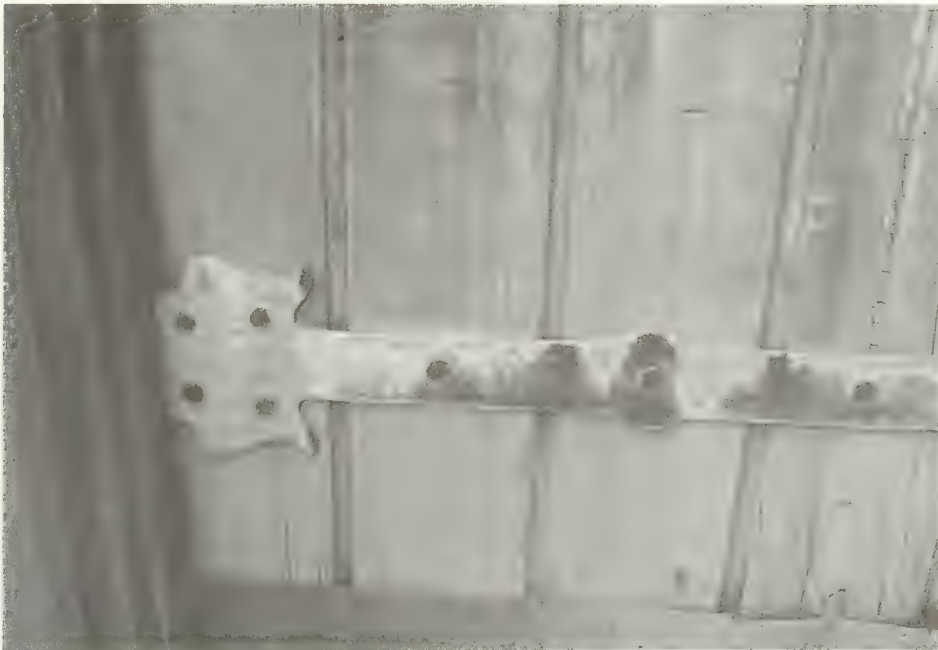


Photo 41: A lower hinge strap. Illustrates the effects of weathering. Note black lacquer primer and bright metal.



Photo 42: Detail of hinge strap. Illustrated in photo 41. Note the presence of what appears to be a clear coat under the black lacquer.



Photo 43: Decorative iron pipe support. Located on the second floor south porch of the Main House. Note the almost indistinguishable combination of actual corrosion and "Old Iron" finish.

COLOR ASSESSMENT

OBJECTIVE

Although few materials systems of Scotty's Castle were painted in the usual sense (with an opaque coating), many features were color "adjusted" or toned using paints or stains to create certain effects, particularly on wood and hardware, sometimes in conjunction with a clear finish. (See the wood and metals chapters of this report.)

Another important material color is that of the stucco. The park is conducting a stucco mix and pigmentation test program to determine both mix and color pigmentation formulas to be used for stucco repair work. See the stucco chapter of this report.

The patio gates are a specific problem in themselves. A paint analysis was indicated in the Task Directive to determine the correct finish and color for maintenance purposes. As described below, historic documentation provides part of the answer.

DOCUMENTATION

Rather than repeat information here, the reader is referred to the wood and metals chapters of this report for historic information on finishes and colors. In time, study of the historic document collection will probably provide more detailed information on colors.

ANALYSIS AND FINDINGS

The patio gates and the lower exterior door of the Annex Flag Tower were probably painted red during the period of the Gospel Foundation's operation of the site. A maintenance painting was done by the park about 1976.

Original specifications indicate that the early finish was likely to have been the same as other exterior wood treatment -- burned with a clear finish.⁹⁵ Historic photographs show that the gates and Flag Tower door originally had a clear finish and that this was retained through the early 1950s.⁹⁶ A stain may have been used in conjunction with a clear coating. It is also possible that the inside surface of the Flag Tower door may have been finished differently than the exterior surface. Clues can be found on frames or trim of doors.

Some exterior metal railings, especially those at ground level, appear to have been painted dark green. There is evidence of this same color on the basement level window grills. Metal window sash were also painted; in protected locations the color is olive green. However, most metals did not receive a uniform single color coating. Much exterior and interior hardware, such as door and shutter hardware, and elements such as light fixtures were treated to have an aged, even rusty appearance yet actually having a protective coating.

95. Personal conversation with George Voyta, April 1990.

96. Historic photographs in the archives showing a natural finish on the patio gates and the Flag Tower door include numbers 14348, 15053, 16908 (also 18290), 18347, 18349 (also 18368), 18483-4, 18486-7, 18529, 18530-43 (1931), 18648, 18652, 18779 (ca. 1950), 18781-82 (ca. 1950-54), 18784-5, 18984, 19331, 20221.

In general, there was a consistency of approach in the original work of producing finishes to highlight the natural characteristics of wood or produce an aged appearance to either wood or metal. In addition wood and metal features were finished within the thematic concept of individual rooms as well as the overall building complex. There is a great variety of finish variation yet this was achieved within an overall uniformity of effect.

ALTERNATIVE TREATMENTS

Since color is an integral part of a finish system, it has to be dealt with in the context of that system, both from the standpoint of priorities for preservation treatment and the materials and techniques involved. Therefore any alternatives of material use or methodologies are directly related to the procedures employed for wood, metals or stucco treatment and reference is made to those chapters.

RECOMMENDATIONS

When treatment of wood, metals or other materials is undertaken, part of the preparatory analysis is to determine the aspects of the finish system, what materials were used, what colors and how it was done.

A color analysis should be undertaken for both wood and metal elements as recommended in those chapters of this report.



Photo 1: Flag Tower doors, unpainted. Similar photos include numbers DEVA-15053 and DEVA-16908. Frasher photo, ca. 1932-40. DEVA 18290, S-0644.

CLIMATE CONTROL SYSTEMS ASSESSMENT

OBJECTIVES

The existing indoor climate control systems at Scotty's Castle will not maintain conditions necessary for the long-term preservation of historic objects, furnishings, and finishes in the buildings. In addition, the existing heating system piping is failing and causing damage to the interior finishes of the buildings, and the use of fuel oil is causing damage to furnishings in the Castle. The purpose of this assessment is to document historic space conditioning systems, document space conditioning systems that are being used presently, to present alternatives to these systems that will provide acceptable levels of interior climate temperature and humidity conditions, and to select a comprehensive climate control system from the alternatives presented that will provide museum quality interior conditions at a reasonable cost.

Drawbacks and limitations of the historic and present systems are discussed in this assessment. Potential solutions to existing problems, in the form of existing building treatments and comprehensive climate control systems, are presented along with any impacts these existing building measures and comprehensive systems might impose on the historic structures. Estimated costs for installation, operation, and maintenance of the new treatments and systems are also included. Criteria used in comprehensive system selection includes system costs, impacts on the historic fabric and historic scene, landscape impacts, environmental impacts, acoustical impacts, installation and operational flexibility, level of complexity, degree of control of interior conditions, fire safety, water damage potential, and emergency generation load. Final comprehensive system selection also considers the reversibility of any impacts that the system installation may impose on the structures. Other impacts that may be caused by the implementation of the climate control system are discussed.

RECOMMENDATIONS SUMMARY

Either before or during the construction of a comprehensive climate control system, the existing building treatment of improvements to the building envelope is recommended for implementation to reduce outside air and dust infiltration. When the design and construction of a comprehensive climate control system becomes feasible, it is recommended that the existing heating system be deactivated in stages and all of the existing humidifiers be removed in stages. It is recommended that these systems be replaced with a comprehensive heating, ventilating, and air conditioning system consisting of package-type water source heat pumps with electric (electrode boiler type) humidifiers to provide museum-quality control of interior conditions. It is also recommended that this system be installed by the park staff as much as possible using day labor. The nature and configuration of this system is such that it may be installed in stages as funding allows. Recommended interior conditions to be maintained in the Castle are 70 degrees F in the summer, with a gradual decrease to 60 degrees F in the winter, maintaining 40 percent relative humidity year-round.

The recommended system will consist of individual packaged water source heat pump units, with one unit per conditioned zone. The exact numbers and sizes of the units, and the configuration of the zoning will be determined in the actual design phase. Ductwork will connect the heat pump units to the individual spaces. A water supply piping system will be connected to the existing spring-fed water supply in the basement of the Main House and will distribute water to the individual heat pump units. Waste water piping from the heat pump units will be discharged into the existing drainage piping that currently serves the Pelton wheel generator.

Condensate drainage from the units (water condensed out of the airstream in the cooling mode) may be discharged into this same drainage piping or may be discharged into existing floor drains. Each zone will have its own thermostat and humidistat to control the operation of that zone's unit. A new electrical system, with new transformers, panels, and distribution wiring will be installed to supply the heat pumps with power.

The heat pumps can be installed in the Main House basement and in the Annex first floor areas. This will reduce the impact to the historic fabric that would be caused by the installation of the units and will hide them from public view. The only portions of the system that may be visible in the public spaces will be the air inlets and outlets, and the thermostats and humidistats. In some areas, historic grilles and other existing openings can be used as air inlets and outlets; in other areas, grilles that will match the historic character of the buildings can be used.

A typical water source heat pump unit of the type proposed for this project will be in the size range of 23" wide x 40" high x 22" deep for a nominal 1 ton⁹⁷ unit to 48" wide x 73" high x 24" deep for a nominal 5 ton unit. All of the units will be on casters for portability if major service or replacement is necessary, and will be capable of passing through a standard doorway. See photograph at the end of this chapter for an example of this type of unit.

DOCUMENTATION

Heating Systems

The present primary heating system is historic and consists of a one-pipe steam heating system with an oil-fired, cast-iron sectional steam boiler in the basement of the Main House and cast-iron radiators distributed throughout various spaces of the Main House and Annex structures.

In a one-pipe steam heating system, a single pipe is used to connect a terminal unit (in this case, a cast iron radiator) to the steam main from the boiler. These branch piping connections and the steam mains convey steam and condensate simultaneously. In this particular system the steam mains in the Main House are arranged in two loops, one loop for the west end and one loop for the east end and Living Hall. These loops are pitched such that the steam and condensate flow in the same direction, with the condensate returning to the boiler by gravity through a "Hartford Loop" (pressure equalizing) connection. A separate steam main supplies the Annex. This steam main splits in the mechanical tunnels just north of the Main House under the central patio. One branch of this main supplies steam to the west end of the Annex, including the bedroom area over the enclosed patio; the other branch supplies steam to the east end of the Annex. These branch mains are pitched such that the majority of the condensate flows in the opposite direction of the steam and returns to the boiler via the west Main House loop. The branch main supplying steam to the Upper Music Room apparently was not able to be pitched back toward the boiler; the condensate is wasted to a drain through a float-and-thermostatic trap in the chase space adjacent to the Tower. No heat from this system was provided to the Organ Blower Room, Refrigeration Plant, Organ Chambers, or bathroom north of the Commissary. Heat in the main portion of the basement is provided by heat loss from the boiler and steam piping. A branch from the east Main House loop supplies steam to the Commissary. All of the steam piping is insulated with asbestos-bearing insulation (this issue is discussed in the analysis discussion of this chapter). Thermostatic air vents have been provided on each radiator to relieve

97. 1 ton = 12,000 BTU (British Thermal Units) per hour cooling capacity

noncondensable gas (air) from the radiators so that they can fill with steam and produce heat. When all of the air has been vented and the steam reaches the air vent, a thermostatic element closes the vent valve. The boiler firing is controlled by a single thermostat in the southeast vestibule off of the Living Hall.

Several modifications and repairs have been made to the system in recent times. The burner on the boiler was converted from fuel oil to propane sometime during the Gospel Foundation tenure. The heating system was worked on extensively in 1972; some of the original piping configuration was changed to eliminate water hammer, the boiler firebox was rebricked, and a pot-type chemical feeder was added. Thermostatic controls were also added at this time (apparently the original system had none).⁹⁸ Sometime around 1976-77, the boiler burner was reconverted back to fuel oil, based on engineering and safety recommendations.^{99, 100, 101} The park maintenance staff has indicated that the burner was replaced again in 1987 and that the firebox was rebricked again in 1988. The chimney and the boiler were both cleaned during the winter of 1988-89. According to the park staff, the chimney is in good condition.

Fuel oil for the boiler operation is supplied from two 3,800 gallon storage tanks located in the basement tunnel system west of the Main House. Fuel is drawn out of the tanks by the fuel pump on the boiler burner through a 1/2-inch supply pipe. The length of the run of the supply pipe and the fact that the tanks are located at a lower elevation than the boiler burner pump cause a periodic loss of prime at the pump and subsequent shutdown of the boiler. Repriming of the fuel supply line then becomes necessary to resume boiler operation.

The radiators in the Commissary and Mrs. Johnson's apartment have been removed, but are still available (they are stored in various locations in the buildings). The branch piping supplying Mrs. Johnson's apartment has been disconnected in the mechanical tunnel running under the east end of Mr. Johnson's Office, and the riser stubs coming out of the floor in the Apartment that were previously connected to the radiators have been filled with grout.

The boiler and radiators appear to be in good condition and are currently being used to heat portions of the buildings, although they will not maintain comfort conditions at winter design temperatures (see temperature data at end of chapter). Temperatures in the Annex are consistently lower than temperatures in the Main House due to the long piping runs to the Annex, ineffective piping insulation, and the fact that there is only one thermostat which is located in the Main Building. The valve in the steam main supplying the Annex was repaired in early 1990. The piping interior at the valve location was inspected at that time and was found to be in good condition. Repair of the valve has improved the heat supply to the Annex considerably. Almost all of the other valves in the system are frozen in position to one extent or another and cannot be operated easily.

98. Beamer/Wilkinson and Associates. "Engineer's Report, Survey and Investigation of Utility Systems, Death Valley Ranch, Scotty's Castle" (November 1973).

99. Ibid.

100.100. Memorandum D50/D5023-DSC-MPG. "Maintenance Assistance - Death Valley National Monument" (April 15, 1976).

101. Memorandum A5427. "Trip Report - Visit to Death Valley National Monument" (March 30, 1977).

The thermostatic air vents tend to leak condensate, especially the ones on the radiators in the Living Hall in the Main House. This is an undesirable condition considering the damage that can be caused to the building and its contents. The use of fuel oil as a heating fuel is also suspected of causing deterioration of some of the furnishings in the Main House, especially the leather curtains. An analysis performed by Harper's Ferry confirmed that fuel oil was a major contributor to the deterioration of the curtains. During the winter of 1990-91, three steam piping failures occurred, two in the Main House basement area and one inside the east wall of the Kitchen. The two leaks in the basement area caused little damage and were easily repaired; however, the leak in the Kitchen wall wetted the interior plaster and stained the wall. Even after the wall was dried out, the staining remained and some efflorescence on the plaster has occurred.

Other heating systems (in addition to the primary steam heating system) have been used or are in current use in the Main House and Annex. A vented propane-fired room heater was provided in Mrs. Johnson's Apartment. This heater was installed at the time that the Apartment was being used as park housing, but was removed in the summer of 1989 so that the Apartment could be included as part of the interpretive tour. Recessed electric wall heaters have been provided in the Organ Chambers, and a portable electric heater has been placed in the Roll Player Room to supplement the steam radiator in that room. The Commissary, which served as the curatorial staff office until the time of the Cookhouse fire in 1991, was heated with a portable electric heater. The area of the basement that currently serves as office and darkroom space is heated with a through-the-wall heat pump. These systems are all functional but, with the exception of the gas-fired heater that was installed in the apartment, will not maintain comfort conditions at winter design temperatures (see temperature data at end of chapter).

Cooling Systems

Historically, cooling in the Main House (and to a certain extent, humidification) was provided by an evaporative cooling system. The best description of this system was given by one of the original architects of the project, Martin de Dubovay.¹⁰² Burlap was hung in the tunnel that runs between the east and west portions of the Swimming Pool and was wetted with a pipe manifold system from above. Large fans drew outside air through the wetted burlap and forced it into the basement, and from there into the house proper through duct risers and grilles installed for that purpose. According to de Dubovay, this system maintained comfortable conditions in the Living Hall at summer design temperatures. This system was removed sometime in the past and no trace of it remains.

Evaporative coolers were installed in the north windows of the Italian Room and Upper Music Room, and in the observation tower above the Living Hall during the Gospel Foundation tenure. There may have been other evaporative coolers installed; the park staff is not sure of these. The use of the cooler in the observation tower was discontinued in 1983-84 because of water damage at the top of the stairs leading to the observation tower, and water damage of the floor of the observation tower where the cooler was installed. This cooler was removed in 1986 or 1987. The other coolers mentioned above have been removed also.

Mrs. Johnson's Apartment and Mr. Johnson's Office are currently cooled with horizontal discharge evaporative coolers. These coolers are mounted outside on stands on the north walls of these spaces, with the cooler supplying the Apartment discharging into the Apartment

102. Holland, Ross, et. al. "Transcript of Tape of Tour of Scotty's Castle, Death Valley N.M." (June 1972).

bathroom through the bathroom window on the north face of the Annex and the cooler supplying the Office discharging directly into the Office through its northeast window. Both coolers have heavy mineral deposits on them, a result of the high mineral content of the water at the site. According to the park staff, the cooler supplying the Apartment is quite effective in maintaining comfort conditions, but humidity control is poor.

The Commissary was cooled with a window air conditioner and the basement office/darkroom area is currently cooled with a through-the-wall heat pump (same unit as mentioned under Heating Systems above). The window air conditioner was installed and removed on a seasonal basis; the heat pump is permanently installed. According to the park staff, the air conditioner in the Commissary helped considerably, but would not maintain comfort conditions at summer design temperatures.

During the summer and fall of 1990, the park staff installed a 3 nominal ton¹⁰³ portable air conditioner with integral electrode boiler humidifier in the basement of the Main House to examine the effects of cooling on the building and its contents. This air conditioner was connected to the existing ductwork for the Kitchen and Dining Room on the first floor and the Johnson's Bedrooms on the second floor. The unit was able to maintain temperatures in the low 70's inside these areas with outside temperatures above 100 degrees F. The variation in indoor temperature was around 1 degree F over a 24 hour period. Humidity was maintained at 38-40 percent relative humidity upstairs and in the low 30's downstairs with a variation of 2-3 percent over a 24 hour period. This experiment was repeated in 1991, with similar results.

Ventilating Systems

The only controlled ventilation systems presently installed in the Main House and Annex are the evaporative coolers in Mrs. Johnson's Apartment and Mr. Johnson's Office, and ventilation air provided by the through-the-wall room heat pump in the basement office/darkroom.

Ventilation of the Organ Blower Room, Organ Chambers, and Upper Music Room occurs in a rather uncontrolled fashion by the introduction of unconditioned outside air into these spaces by the operation of the organ. The west window of the Organ Blower Room has been purposely left open slightly to allow outside makeup air to enter the room. From there it is drawn through filters upstream of the organ blower and introduced into the Organ Chambers and Upper Music Room when the organ is played during the interpretive tour. This would account for some of the excessive temperatures in the Organ Chambers during the summer (see temperature data at end of chapter).

Any other ventilation in the buildings is provided by natural means, i.e., infiltration through cracks around windows and doors, ventilation caused by exterior doors being opened and closed, and air rising up through chases, vent ducts, and other openings due to chimney effect.

103. 1 ton = 12,000 BTU (British Thermal Units) per hour cooling capacity

Humidification Systems

Historically, humidification was supplied to the Main House from several sources. The primary source in the summer would have been the evaporative cooling system described above. Human activities in the space such as cooking, bathing, etc. would have provided some additional humidification. The Jasper Fountain in the Living Hall and the Solarium Fountain were also major sources of humidification. These fountains have been deactivated due to leakage and structural problems.¹⁰⁴ Some time after the fountains were deactivated, cracks began to appear in some of the decorative wooden ceilings in the Main House. Apparently, after having been accustomed to the increased level of humidity provided by the fountains, the wood in the ceilings had some difficulty in adjusting to the lower level of humidity caused by the deactivation of the fountains and cracking occurred due to shrinkage and cell deterioration.

Currently, humidification is provided by portable, evaporative type humidifiers located throughout the Main House and Annex. These humidifiers were installed circa 1984 and are filled by hand on a daily basis, requiring 75 gallons of water a day on the average according to the park staff (17,000 to 22,000 gallons of water annually). Relative humidities are generally maintained in the 30 to 40 percent range, although this varies quite a bit with the season. Also, the daily swings can be quite large at times. The only other humidification currently being supplied is through the humidifier in the experimental 3 ton unit discussed in Cooling Systems above. During the rainy season in the spring, the relative humidities in the spaces can be quite high, especially in the basement (see relative humidity data at end of chapter). Portable dehumidifiers are used by the park staff in these instances to reduce the relative humidity to acceptable levels.

Dehumidification Systems

Historically, there were no dehumidification systems installed in the Castle. Currently, portable refrigerant type dehumidifiers are brought into the affected spaces when the humidity levels increase in the rainy season (see relative humidity data at end of chapter).

Window Treatments

In 1976, the exterior windows of the Main House and Annex had "Solar-X" film applied to their interior surfaces. This film was replaced in 1987 with 3M "Scotchint" film. The purpose of installing the film was to reduce the amount of ultraviolet light transmission through the windows for object preservation, and to reduce the solar heat gain into the interior spaces. In the summers of 1990-91, the park staff added temporary styrofoam (expanded polystyrene) insulation panel inserts in the windows of the area being conditioned by the experimental 3 ton unit (east end of the Main House). These panels were cut to fit tightly in the interior window openings, but still be removable. In conjunction with closing the exterior shutters, the styrofoam panel inserts provided considerable reduction in solar heat gain through the windows.

104. Memorandum A5427. "Trip Report - Visit to Death Valley National Monument" (March 30, 1977).

ANALYSIS

Heating Systems

Up until the winter of 1990-91, it was generally believed that the existing heating system was in relatively good condition and could be used for a number of years until a new climate control system was installed. Several improvements to the existing system were planned to improve its performance in the interim. However, the steam pipe leak in the Kitchen wall has caused some reassessment of the methods and time frame for implementing the comprehensive climate control system. The only practical way to repair a leak of this nature is to remove the damaged section of the wall to gain access to the failed pipe, repair the pipe, and replace the wall. Given the pristine condition of the plaster work in the interiors of the buildings and the inherent difficulty of effecting an undetectable plaster repair, opening up walls that are in excellent condition does not seem to be a viable method of repairing a steam heating system, especially one that is at the end of its useful life. Even if the affected sections of pipe are isolated from the rest of the existing system and temporary electric heat is provided in the spaces left without steam heat, there remains a risk of steam pipes in the active portions of the system developing leaks and causing further, irreparable damage in other portions of the Castle. This makes it imperative to implement replacement of the existing system with a new system as soon as possible.

The fuel oil storage tanks for the boiler could be a problem in the future. According to the park staff, an inspector from Inyo County inspected the tanks in early 1990. The decision made by the county after the inspection was to continue to allow the tanks to be used. This decision was based on the fact that the tanks are encased in concrete, effectively forming a secondary containment. However, this decision may change in the future depending on the underground storage tank regulations in effect at that time.

Concerning the asbestos pipe insulation on the existing steam heating system, the park and region have developed a strategy to deal with the problem. The chronology of events from initial awareness of the potential problem to testing to formulation of strategy is addressed in a series of memos written in early 1988.^{105, 106, 107, 108} The next to last memo in this series presents the agreed upon strategy for dealing with the problem. This strategy consists of limited access to affected areas, employee awareness training, containment (encapsulation with plaster patching and rubber based paint), clean-up (with "HEPA" vacuum cleaner), labeling of asbestos insulation, annual monitoring of encapsulation, and air quality testing.

The asbestos abatement strategy outlined above, or an equivalent one using other acceptable abatement techniques, should be implemented before or concurrently with installation of new systems or modification of existing systems. This will be necessary to protect construction personnel from potential asbestos exposure.

105. Memorandum A7615. "Asbestos Hazard Scotty's Castle" (February 7, 1988).

106. Memorandum A7615. "Asbestos Analysis" (April 25, 1988).

107. Memorandum A7615. "Asbestos Insulation at Scotty's Castle" (April 26, 1988).

108. Memorandum A7615. "Asbestos Insulation at Scotty's Castle" (May 20, 1988).

Temporary Heating Systems

Any temporary electric heaters that are utilized in areas where the existing heating system has failed should be of the low intensity (oil-filled) type to reduce potential fire hazards.

Cooling Systems

Consideration has been given to constructing an evaporative cooling system similar to the historic one described earlier. There are several problems with this proposal. First, the air quantity required to achieve reasonable temperature conditions in the buildings with evaporative cooling is excessive - approximately 25,000 CFM (cubic feet per minute) to maintain both the Main House and the Annex at 85 degrees F at summer outdoor design conditions (assuming an 80 percent evaporative cooler saturation efficiency). Mechanical refrigeration would require only about 12,000 CFM to maintain 70-75 degrees F at summer outdoor design conditions. Second, distributing this amount of air would require substantially larger ductwork than with mechanical refrigeration, a definite problem when space is limited as in this case. Third, accurate space conditions (both temperature and humidity) necessary for a museum environment would be difficult to maintain due to the fact that this system uses 100 percent outside air. Fourth, this type of system would require substantial maintenance due to the large quantities of water that would be evaporated (around 100 gallons per hour at summer outdoor design conditions). The high mineral content of the water at the site causes excessive buildup of solid minerals on the media of evaporative cooling equipment; the media need to be cleaned or replaced often to maintain full efficiency of the equipment. Fifth, open water sources in the tunnels encourage the growth of algae and breeding of insects. Last, the historic cooling system relied on the tunnels in the basement and small duct risers to distribute air within the buildings. This open type of air distribution presents a fire hazard of the first degree. These openings would provide pathways and chimneys for fire such that it would spread rapidly into many areas of the buildings. No matter what type of system is installed in the future, the current tunnel and duct riser configuration needs to be modified in accordance with governing codes (this issue will be discussed in the treatment discussion of this chapter). Objections similar to those enumerated above apply to modern, ducted evaporative cooling systems also.

The existing evaporative coolers in Mrs. Johnson's Apartment and Mr. Johnson's Office suffer from excessive mineral deposits and detract from the historical appearance of the Annex. The through-the-wall heat pump in the basement office/darkroom area does not provide adequate comfort conditions and is a temporary solution at best. No cooling systems exist anywhere else in the buildings and space temperatures in these areas become excessive during summer outdoor design conditions (see temperature data at end of chapter).

Ventilating Systems

Introduction of outside air into the Organ Blower Room not only contributes to excessive temperatures in the Organ Chambers but also increases the amount of airborne contaminants (dust, pollen, etc.) that the filters upstream of the organ blower must remove. A transfer duct between the Organ Chambers and the Organ Blower Room should be provided so that air discharged from the organ pipes may be recirculated to the organ blower. The west window of the Organ Blower Room can then be closed so that the interior space may be conditioned properly.

No other ventilation systems other than natural means (leakage through cracks and other building openings, and opening and closing of doors and windows) and the window air conditioner, heat pump, and evaporative coolers referred to above have been provided in the buildings. High winds in the area cause extensive air and dust infiltration into the buildings; a modern system that provides pressurization of the building with respect to the outdoors would be desirable to attenuate the air and dust infiltration.

Humidification Systems

The existing portable humidifiers provide some measure of humidification but presently cannot maintain the close control of humidity levels required for a museum environment without adequate space temperature control. Operation and use of these humidifiers also present some problems. First, they require manual filling on a daily basis. This represents a potential water damage problem due to spillage and also ties up personnel unnecessarily. Second, they require considerable maintenance in the form of cleaning to remove mineral deposits formed by the evaporation of the high mineral content water at the site. Third, they represent a direct intrusion on the historic scene inside the buildings. Humidification of the Castle will be successful and economical only when the building envelope is sealed sufficiently to retain the moisture produced by the humidifiers and when the temperature is controlled sufficiently to stabilize the indoor relative humidity.

Reactivation of the fountains in the Main House should not be relied upon for total humidification. Historically the fountains, and to a certain extent the tunnel cooling system, supplied the majority of the humidification for the buildings. However, like the portable humidifiers, the fountains cannot maintain the close control of humidity levels required. Also, because of their location, the fountains will only provide humidification in the Main House and not in the Annex.

If electrode boiler type humidifiers are used in a comprehensive climate control system, consideration should be given to providing a water softening system for the humidifier supply water to reduce humidifier maintenance.

Humidification Requirements

Psychrometric analysis indicates that the humidification requirements for these buildings will be very small in the summer and will increase to substantial levels in the winter with indoor conditions maintained at 70 degrees F and 40 percent relative humidity year-round. Generally speaking, if the indoor temperature in the summer is increased, the humidification requirements will increase, resulting in little or no energy savings; if the indoor temperature in the winter is decreased, the humidification requirements will decrease, resulting in both heating and humidification energy savings.

Dehumidification Requirements

During the rainy season in the spring, dehumidification may be required in most of the areas in the buildings (see relative humidity data at end of chapter). Bringing separate dehumidifiers into the affected spaces and activating them for the duration of the rainy season is the method that is currently being used. This method could continue to be implemented if it is not feasible

or desirable to provide dehumidification capability in a comprehensive climate control system. The major drawbacks of the current method are the time lag between the realization that dehumidification is required (hygrothermograph readings) and the activation of the equipment, and the fact that the equipment needs to be physically brought into and taken out of the buildings.

Practical dehumidification can be provided by a comprehensive climate control system using cooling and reheat. This involves first cooling the air below its dew point temperature through the cooling coil in an air handling apparatus to remove moisture, and then reheating the air with a heating coil in the same air handler to maintain set space temperature conditions. In a heat pump arrangement an auxiliary heating coil, downstream of the heat pump coil, would need to be provided for the reheat function. The cooling and reheat scheme, while providing good control of space conditions, has some disadvantages. The cooling and reheat method requires that both cooling and heating occur simultaneously, resulting in an energy penalty (increased consumption and increased demand). This energy penalty can be mitigated to a certain extent by using heat recovery (recovering heat normally wasted to the atmosphere or cooling water by the air conditioning equipment), but at the expense of increased system complexity, installation costs, and maintenance costs.

It must be kept in mind that the problems associated with the current dehumidification method (portable dehumidifiers), in contrast with the cooling and reheat option presented above, may be acceptable given the relatively short duration of the weather that gives rise to the excessive indoor humidity levels. Psychrometric analysis shows that using a comprehensive climate control system with no additional dehumidification capabilities may allow the space relative humidity to rise to around 65 percent during the rainy season. Due to the complexity and expense of adding dehumidification capability to a comprehensive climate control system, the lower expected maximum relative humidity limits afforded by a comprehensive climate control system, and the relatively short duration of the excessively humid exterior conditions, it is not recommended to implement dehumidification capability in a comprehensive climate control system.

Humidity Limitations

Care must be taken in the design and control of any new humidification systems that are installed in conjunction with adequate heating and cooling systems to assure that humidity levels maintained in the colder parts of the year do not contribute to condensation in or on any of the building components. This has been a problem not only in older buildings that have no vapor barriers (air barrier is more accurate terminology), but also in newer buildings with vapor barriers that were improperly designed or installed.¹⁰⁹

Calculations indicate that with outdoor design conditions of 30 degrees F with a 15 mile per hour wind, condensation will begin to occur on window surfaces (single glazing) with indoor conditions of 70 degrees F and 33 percent relative humidity. If the interior temperatures are decreased to 65 or 60 degrees F, the maximum allowable relative humidity levels increase to 40 or 46 percent, respectively.

109. Padfield, Tim. "The Dangers of Installing Air Conditioning in Historic Buildings" ICOMOS 8th General Assembly and International Symposium, October 10-15, 1987, Symposium Papers, Volume I.

The frame wall constructions common to the Main house and Annex second floor may have condensation occurring at the insulux/clay tile interface with outdoor conditions of 30 degrees F and 70 percent relative humidity, and indoor conditions of 70 degrees F and 35-40 percent relative humidity. Analysis of all other wall and roof constructions for the Main House and Annex indicate that no condensation should occur in these constructions at those same conditions. Reductions in indoor temperatures will allow increases in the indoor relative humidity levels for the walls and roofs much the same as for the windows.

The results of the wall and roof condensation analyses presented above are based on moisture diffusion models. Since analyses involving the diffusion of moisture through wall and roof constructions have not proven highly accurate due to the variation of moisture permeability of materials with temperature and humidity, and given the realization that air leakage is usually a more significant mechanism for moisture transfer than diffusion through materials, the results of the analysis presented above should only be used as general guidelines.

Given the information presented above, the control strategy for a Castle climate control system should include reduction of interior temperatures in the winter to 60 degrees F, and limitation of the indoor relative humidity levels to 40 percent at this temperature. This will not only have the effect of saving energy due to the reduced interior temperature in the winter, but will also save humidification energy since the total moisture level (absolute humidity) of air at 60 degrees F is lower than that at 70 degrees F (at a constant relative humidity).

Window Treatments

The use of window films has proven effective in reducing ultraviolet light transmission and solar heat gain, and should continue to be maintained in place. However, the use of the temporary insulation panel inserts has some potential drawbacks. First, the material being used currently (expanded polystyrene) is highly flammable and highly toxic fumes are produced when this material burns. Second, outgassing occurs when the material is initially installed and continues to occur during breakdown of the material by ultraviolet light. Last, there is a possibility that using the insulation panel inserts in the colder part of the year may cause condensation on the interior surfaces of the windows. Installing the panels will cause the temperature of the interior surface of the glass to decrease; moisture in interior air leaking past the panels into the space between the panels and the glass will condense on the glass, especially if the recommended interior level of relative humidity is maintained. The use of these panels for the reduction of heat gain/loss and ultraviolet light control should not be continued or expanded until further evaluation of their potential effects can be performed.

Air Filtration

The amount of air filtration required depends on several factors. The first has to do with energy consumption. Generally, the more efficient the filtration, the more pressure drop the filter imposes on the system, and consequently more energy is required to convey the system air through the filter. Secondly, the extent of the filtration will depend on the location of the project. Given the rural air quality at the Castle site, filtration for soot (particles less than 1 micron in diameter) and gaseous pollutants created by combustion of fossil fuels should not be necessary. This should eliminate the need for activated charcoal or high efficiency (HEPA) filtration. Third, the particulate removal efficiency increases with reductions in outside air quantities (increased amounts of recirculated air). With a filter efficiency of 60 percent and 10 percent outside air

quantity, the filter will remove approximately 97 percent by weight of the particulates, while the same filter with 50 percent outside air will only remove about 75 percent.¹¹⁰ Improving the performance of the building envelope as outlined in the treatment discussion below will reduce the amount of outside air and wind driven dust that will enter the building by natural means, allowing a greater degree of pollutant management by the climate control system. Last, the type of equipment selected for a climate control system will have some bearing on the type of filters selected. While a large, central type of air conditioning system may be able to use thicker, more efficient filters with a higher pressure drop, smaller package type equipment may only be able to use thinner, less efficient filters with a lower pressure drop.

Electrostatic precipitators or electronic air cleaners should not be used in any case because they form ozone, which is detrimental to museum collections.

Design Conditions

Outdoor design conditions used for the Castle analyses are as follows:

Summer 105 Degrees F Dry Bulb
65 Degrees F Wet Bulb (8 percent relative humidity)

Winter 30 Degrees F Dry Bulb
27 Degrees F Wet Bulb (70 percent relative humidity)

Consideration was given to published recommendations for museum climate control indoor design conditions. The consensus appears to be that control of relative humidity in the range of 40 to 65 percent with a change of no more than 5 to 15 percent per month is essential for a museum climate. In other words, the relative humidity level should be as constant as possible within this given range. The upper limit of 65 percent is commonly called the "mold limit". Relative humidity needs to be controlled below this limit to prevent the formation of mold. The lower limit of 40 percent is the minimum relative humidity that is recommended to be maintained to prevent object cracking, warping, or brittleness. However, this limit could possibly be lowered somewhat for a semi-arid climate such as the one these buildings are located in, since the buildings and their contents have adjusted to lower relative humidities over the years.^{111, 112, 113} As discussed in Humidity Limitations above, 40 percent relative humidity will actually be an upper limit in the winter as far as the buildings themselves are concerned.

The temperature in the space has less of an impact than the relative humidity levels, but still must be controlled to achieve acceptable conditions. The recommended range for temperature is somewhere in the range of 60 to 75 degrees F. Again, as with the relative humidity levels, the temperature should be held as constant as possible because of the destructive effects of expansion and contraction. Also, the relative humidity is dependent on the temperature. At a constant moisture level (constant absolute humidity), the relative humidity will decrease as the

110. Thomson, Garry. "The Museum Environment" London: Butter-worths, 1986.

111. Ibid.

112. Bingaman, Gordon B. "Creating a Museum Environment in Death Valley" (December 1988).

113. Lewis, Ralph H. "Manual for Museums" Washington: National Park Service, U.S. Department of the Interior, 1976.

temperature increases; conversely, the relative humidity will increase as the temperature decreases. Therefore, the temperature must be controlled in a fairly tight range to maintain good humidity control.

Studies have shown that the minimum energy consumption for a comprehensive climate control system occurs when the indoor conditions are maintained at 70 degrees F and 50 percent relative humidity year-round. This was shown to be the case using a computer model for the same building in five widely varying climates in the U.S.^{114, 115} Given the fact that the climate at the Castle is hotter and drier than any of the climates modeled in these studies (driest = Albuquerque, NM), and that damage from condensation may occur at higher indoor humidities in the winter, reducing the indoor relative humidity from 50 percent to 40 percent should not incur any energy penalty at the Castle.

Based on this discussion, and the discussion in Humidity Requirements and Humidity Limitations above, the recommended indoor design conditions for the Castle are 70 degrees F in the summer, with a gradual decrease to 60 degrees F in the winter and 40 percent maximum relative humidity year-round. These indoor design conditions should be verified by performing a curatorial study to investigate how different objects in the Castle will react to these conditions. It needs to be kept in mind that the limiting factor for relative humidity will be the building envelopes, and any objects that require higher levels of humidity than the maximum levels recommended for the buildings proper will need to be removed from the Castle and placed in suitable curatorial storage elsewhere, or placed in climate controlled enclosures in the Castle.

Alternative Energy Sources

To complete the analysis of indoor climate control systems for Scotty's Castle, some renewable energy sources for powering a climate control system as alternatives to conventional electric or gas sources will be examined below.

Hydroelectric Power. Maximum flow rate recorded by independent sources for the spring supplying water to the Castle development was 206 gallons per minute (GPM) in 1973.¹¹⁶ This corresponds well with the park staff's recent measurements of 190 GPM maximum flow rate. Given that the elevation difference between the reservoir and the point at which a turbine would be located near the Castle is approximately 300 feet, the maximum power that could be generated by hydro power if all of the water available were diverted through the turbine would be around 14.1 horsepower (10.5 kilowatts).

Given that the alternative climate control systems that would need to be installed to provide an acceptable climate in the interior of the Castle would require anywhere from 60 to 140 kilowatts (KW) to operate, hydro power for this purpose at the Castle does not appear to be feasible without substantially increased flow from the springs. Flow rates required would be around 1,180 and 2,750 GPM for 60 and 140 KW turbine outputs, respectively.

114. Ayres Ezer Lau Consulting Engineers. "Energy Conservation and Climate Control in Museums" (November 1988).

115. The Getty Conservation Institute. "Environmental Research at the Getty Conservation Institute: Background, Recent Findings and Goals 1984-1989" (September 1989).

116. Beamer/Wilkinson and Associates. "Engineer's Report, Survey and Investigation of Utility Systems, Death Valley Ranch, Scotty's Castle" (November 1973).

Active Solar with Absorption Chillers. Based on 6000 square feet of flat plate solar collectors with single glazing and a selective surface on the absorber, and lithium bromide absorption chillers with a coefficient of performance of 0.65 at peak conditions, the amount of energy that the solar system could provide to both heat and cool the buildings would be in the neighborhood of 72 percent of the total energy required. The law of diminishing returns is at work here, as illustrated by analyzing this system with 10,000 square feet of collector surface. Increasing the collector area 67 percent only provides an increase of 11 percent in the amount of energy that the solar system could provide (83 percent with 10,000 square feet of collector). The remainder of the energy needed to heat and cool would have to be provided by conventional electric or gas sources. In addition, all of the energy required to operate the pumps, fans, and humidifiers would have to be provided by conventional sources.

Space on the site fairly close to the Castle would have to be provided for the collectors. The space required would be on the order of 1/4 acre (11,000 square feet) for 6,000 square feet of collector surface, including space for piping and access, and separation area between collectors so that no shading occurs. The thermal storage tank size required would be around 10,800 gallons. Given the excessive amount of space required for the collectors and the thermal storage tank, the impact that the collectors would have on the exterior historic scene, the fact that the lithium bromide chillers require unique maintenance procedures, and that the cost for the collectors alone, with their associated mounting structures and piping, would be on the order of \$330,000 (not including grading, site work, fencing, concrete footings, etc.), active solar for this purpose at the Castle does not appear to be feasible.

Photovoltaic Solar. The problems associated with the implementation of a photovoltaic system will be similar to those presented above for active solar. At peak conditions for the 60 KW system (air-cooled chiller with ice storage and gas-fired heating) and with a photovoltaic collector efficiency of 10 percent, the collector area required would be on the order of 6,800 square feet (proportionately more area would be required for the systems with higher KW ratings). Storage batteries and power conditioning equipment would also be required. Given the collector space required, and the cost for the collectors, batteries, and power conditioning equipment (this cost would be in addition to the cost to install the base climate control system), photovoltaic solar for this purpose at the Castle does not appear to be feasible.

TREATMENT

Existing Building Treatments

There are several treatments that could be implemented before or during the installation of a comprehensive climate control system. These treatments will contribute to improved control of interior conditions, with or without a comprehensive climate control system in place. The treatments are arranged somewhat in order, from the ones having the greatest effect on the interior climate to the ones having the least effect.

Building Envelope Improvements. Out of all of the existing building treatments proposed here, improving the performance of the building envelopes will probably result in the largest improvement in indoor conditions due to decreased infiltration of untreated outdoor air. There are also some potential fire safety problems that can be solved at the same time.

Openings from the basement of the Main House into the basement tunnels and through the first floor should be sealed off or protected in some fashion. Fire doors with closers and weatherstripping should be provided on all tunnel connections to the basement. This would effectively seal off the basement from exterior conditions and would also provide partitioning for fire control. Any openings through the floor that will be used for ductwork or air transfer should be fitted with fire dampers. All unused floor openings should be sealed off completely to prevent uncontrolled air transfer and to prevent fire from spreading to the upper floors. Any openings from the tunnels into the Annex should also be protected with fire doors, fire dampers, or be sealed off.

Weatherstripping and sealing of the upper floors of the buildings should be done within the constraints of the architecture. Sealing strips should be applied to the windows. Since the existing windows are metal casement type, the sealing strips can be applied while the windows are open and will be concealed when they are closed. Concealed sweeps at thresholds and weatherstripping on heads and jambs should be applied to all exterior doors. Openings into unconditioned spaces and chimney flues should also be sealed off. A transfer duct between the Organ Chambers and the Organ Blower Room should be installed as described in the analysis discussion above so that these spaces can be sealed off from the exterior.

To obtain the best results from weatherstripping and sealing the building envelopes, a consultant who specializes in building weatherization should be retained to test the building envelope at various stages and make recommendations for further improvements. They can pressurize the buildings using an "air door" (an exterior door replacement with a fan installed on it), and can determine the amount of leakage and exactly where the buildings are leaking with air flow and pressure instrumentation.

Although the buildings are fairly well insulated because of the "insulex" fill incorporated into the framing, there is a major area that needs to be insulated. The area above the bathroom and corridor adjoining the guest bedrooms in the Annex presently has no ceiling insulation installed. This "attic" space communicates directly with the exterior by means of ventilation louvers installed in the south wall above the Lanai. This space is accessible through a ceiling hatch and could be easily retrofitted with fiberglass insulation.

Improvements to Existing Heating System. Given the fact that a serious piping failure occurred in 1990-91, and that other failures are sure to follow, improvements to the existing heating system should not be given a high priority. However, the portions of the system that are still active need to operate reliably during the comprehensive climate control system installation period. Implementing the building weatherization measures described above should improve the performance of the existing heating system and fire safety considerably in this period. Additional measures can be taken to improve the performance and reliability of the system, and improve fire and life safety as discussed below.

To provide a extra margin of safety and to meet current code requirements, an emergency boiler shutdown switch should be wired in series with the power supply to the boiler (see NFPA 31, "Standard for the Installation of Oil Burning Equipment", latest edition). The switch should be mounted near a basement exit and should be identified with an engraved label (red background with white lettering).

An effective way of solving the fuel oil supply line loss of prime problem would be to install an auxiliary supply pump located at the main fuel storage tanks. This pump should have the same flow capacity as the existing burner pump. The burner controls would be connected to the

auxiliary pump such that it would cycle on and off with the burner. The supply line would be pressurized, eliminating the possibility of loss of prime due to excessive suction pressure drop. An alternative method of solving the problem would be to provide a day tank in the boiler room with its own pump and level controls. The boiler pump would then be connected to take its suction directly from the day tank.

Some improvement of heating control might be realized by relocating the thermostat closer to the center of the Main House. However, since there is still only one thermostat for the entire Castle, simply relocating the thermostat will have little effect on the Annex heating. Due to the nature of a one-pipe heating system where the steam and condensate are both present in the piping, individual zone control or diversion of heat to the Annex by throttling valves or two-position valves in the steam supply lines is not possible without water hammer and condensate return problems. The most desirable steam system would be a two-pipe system with separate steam supply and condensate return lines. The work required to convert the existing system to a two-pipe system would severely impact the building fabric. A practical alternative to a two-pipe system conversion that would provide some semblance of zone control would be to replace the radiator thermostatic vents with new vents (which will mitigate the water leakage problem), and to provide self-contained thermostatic radiator control valves in series with the thermostatic air vents. If the boiler is firing and the thermostatic radiator control valve is calling for heat, air will be allowed to flow out of the vent valve and the radiator will be allowed to fill with steam. If the boiler is firing and the thermostatic radiator control valve is not calling for heat, air will not be allowed to flow out of the vent valve and the radiator will not be allowed to fill with steam. To complete this control scheme, the main thermostat which fires the boiler should be relocated from the Living Hall to the coldest area in the Annex that is heated by this system (near the Bokhara Room as indicated by the temperature data at the end of the chapter). The boiler will fire longer and more often to satisfy the heating requirements of this coldest space, but the thermostatic radiator control valves on all of the other radiators (especially those in the Main House closest to the boiler) will limit the capacity of those radiators so that the areas that they serve do not overheat. This will also assist in providing more steam to those areas that do require heat while the boiler is firing.

Recommendations have been made in the past to provide a fire rated enclosure around the boiler and its associated equipment to alleviate the problems associated with pollutants produced by the boiler operation and to improve the fire safety of the boiler installation. Given that the steam heating system is failing and that immediate implementation of a comprehensive climate control system is recommended because of the steam system failure, the provision of a boiler enclosure is not recommended. Whether or not any of the other recommendations are carried out (other than the addition of an emergency boiler shutdown switch) will most likely depend on the length of time that the installation of a comprehensive climate control system takes.

Fountain Rehabilitation and Reactivation. The effect of reactivating the Jasper and Solarium fountains is difficult to quantify. However, some general conclusions regarding the fountains are presented here. First, as discussed previously these fountains will provide humidification in the Main House, but not in the Annex. Second, the humidification produced by the fountains will occur in an uncontrolled fashion whereas humidification produced by the humidifiers (in whatever form they finally take) will be well controlled. Last, since psychrometric analysis indicates that little or no humidification may be required in the summer, the operation of the fountains at that time may result in an energy penalty if dehumidification is required to control excess humidity produced by the fountains. It is not recommended that the fountains be reactivated for humidification purposes, since humidification systems will be in place to provide accurate humidity control. Reactivation of the fountains should be done solely as an

enhancement of the historic scene in the Main House; operational difficulties that may arise in the humidification/dehumidification of the affected spaces due to the fountains can be planned for in the design of the comprehensive climate control system or dealt with at the time of fountain reactivation.

Shading. Some passive cooling may be realized by providing shade on portions of the Castle. Replacement of the eucalyptus logs over the central patio will have some effect, but it will be very little unless vines with fairly dense foliage can be induced to grow on the logs. Repair of the Lanai should provide a considerable reduction in the cooling load of the central portion of the second floor of the Annex. However, these treatments should be viewed more as restorations of the historic scene than as adjuncts to the climate control system because of their small overall shading effect on the Castle.

The most effective shading strategy that can be employed with a minimum of expenditure would be to close the exterior shutters on those windows that have them during the hotter parts of the year.

Comprehensive Climate Control Systems

Although the existing building treatments described above will make some improvements in the climate inside the Castle by themselves, they do not fully solve the problem. Eventually it will be desirable to install a comprehensive climate control system that will not only heat and humidify, but will also provide cooling, air filtration, and controlled ventilation in an integrated scheme. This system should also be capable of being zoned to account for variations from one space in the building to another, and should have reasonable operating and maintenance costs. Because of the recent piping failures in the existing heating systems, it has become even more critical that a comprehensive climate control system be designed and installed in the near future.

Several system configurations were studied, and the analysis of these systems is presented here. Although improving the operation of the existing heating system does not have the priority that it once had, costs for the existing system and improved configurations of the existing system (Systems 1 through 3) are included for comparison purposes. Brief descriptions of the systems that were analyzed follow:

1. Existing system.
2. Existing system with improvements to heating system (boiler enclosure and asbestos abatement not included in installation costs).
3. System 2 with improvements to the building envelope.
4. Packaged air conditioners with water-cooled condensers, electric resistance heat, and electric (electrode boiler type) humidifiers.
5. Packaged water source heat pumps with electric (electrode boiler type) humidifiers.
6. Central air-cooled chiller with fan-coil units, electric resistance heat, and central electric humidification system.

7. Central air-cooled chiller with fan-coil units, propane gas-fired hydronic heat, and central propane gas-fired humidification system.
8. Central air-cooled chiller with fan-coil units, oil-fired hydronic heat, and central oil-fired humidification system (includes new underground fuel oil storage tank, leak monitoring system, and spill prevention appurtenances).
9. System 7 above with ice storage for peak load shaving.
10. System 5 above with improvements to the building envelope.

System Costs

Estimated costs for each of the systems described above are presented below in a matrix form to simplify comparison.

Installation costs are based on Class "B" estimates for each alternative system. These costs were marked up 25 percent for contractor's overhead and profit, and 30 percent for site remoteness. These markups were done for all of the systems, whether the work would actually be performed by a contractor or not, to put them on an equal basis for comparison purposes.

Annual operating costs were calculated using classical bin method analysis to determine annual energy consumption. This method of estimating energy consumption of a facility is more accurate than simplified single-measure methods such as the degree-day method. Temperature bin data used in the analyses is for Nellis Air Force Base, Las Vegas, Nevada.¹¹⁷ This data was used since there is no bin weather data available for Scotty's Castle; Las Vegas was judged to be climatically similar enough to Scotty's to make valid comparisons (as long as all of the systems being analyzed are modeled with the same weather data, the comparison will be legitimate since the main concern typically in these types of analysis is not in the absolute values of the energy consumption figures for each system, but in the relative differences between energy consumption figures for each system). Energy costs used in the calculations were obtained from the park staff in August/September 1989 and are as follows:

Electrical Consumption	\$0.08675 per kilowatt-hour
Electrical Demand	
Winter	\$2.90 per kilowatt
Summer	\$9.20 per kilowatt
Propane	\$0.65 per gallon
Fuel Oil	\$0.85 per gallon

Annual maintenance costs are based on estimated hours of labor and cost for parts normally required for each type of system.

Life cycle costs are based on a 25 year study period with a 10 percent discount rate (see Appendix for detailed life cycle cost calculations). The discount factors used correspond to a 10

117. Departments of the Air Force, the Army, and the Navy. "Engineering Weather Data, Department of the Air Force Manual AFM 88-29" (July 1978).

percent discount rate, and those that are used with annually recurring energy costs include an average fuel price escalation factor.¹¹⁸

Alternative Climate Control System Costs Table.

System No.	Installation Cost (\$)	Annual Operating Cost (\$)	Annual Maintenance Cost (\$)	Life Cycle Cost (\$)
1	0	4,836	13,293	174,437
2	8854	7,667	14,710	234,186
3	28,964	7,149	11,440	217,480
4	282,407	36,398	5,444	687,353
5	280,064	20,578	6,208	549,697
6	369,390	37,756	4,181	778,212
7	403,398	23,110	5,460	685,626
8	435,556	22,620	5,628	732,703
9	490,081	22,029	6,006	767,881
10	300,174	18,607	5,593	545,458

The annual maintenance costs for improved configurations of the existing systems 1 through 3 are higher than the annual maintenance costs for the comprehensive climate control systems 4 through 10 because of the labor costs associated with filling and maintaining the evaporative humidifiers. The annual maintenance costs for Systems 4, 5, and 10 (individual air conditioning or heat pump units) are generally higher than or comparable to those for Systems 6 through 9 (central systems) since each individual unit has its own compressor and humidifier, requiring somewhat more maintenance than the systems with central cooling and humidifying equipment.

Utility companies typically offer rebates for the installation of systems with ice storage for off-peak cooling or peak shaving, making these types of systems more attractive from an installation cost standpoint. Southern California Edison (SCE, the supplier of electricity to the Castle development) does not offer rebates for these types of systems at this time, making a reduction in the cost of System 9 impossible. SCE does provide rebates for certain water source heat pumps and air conditioners, however, making it potentially possible to reduce the installation costs of

118. U.S. Department of Commerce "Energy Prices and Discount Factors for Life-Cycle Cost Analysis 1990" (May 1990).

Systems 4, 5, or 10. These rebates amount to \$4 per KBTU¹¹⁹ for units with an EER¹²⁰ of 10 or greater and \$8 per KBTU for units with an EER of 11 or greater.

Comprehensive Climate Control System Comparison

Since some of the advantages/disadvantages of the comprehensive systems described above are not readily quantifiable in terms of dollar costs, relative "point" values have been assigned to the various criteria that are of interest for this facility. Criteria for comparison have been rated on a scale from one to five, one representing worst and five representing best. The comparison criteria and the point values for each criteria for each system are presented below in a matrix form to simplify comparison.

Only Systems 4 through 10 are compared here since they will all provide similar levels of comprehensive environmental control and are mutually exclusive. Systems 1 through 3 will not provide the same levels of control and are not mutually exclusive with respect to Systems 4 through 10; therefore only the comprehensive control systems will be compared so that "apples" are not being compared to "oranges".

119. Thousand British Thermal Units

120. Energy Efficiency Ratio - British Thermal Unit per hour output divided by kilowatt input for a particular piece of equipment.

Comprehensive Climate Control System Comparison Table.

Criteria	System No.						
	4	5	6	7	8	9	10
System Installation Impact	4	4	3	2	1	1	3
Interior Historical Scene Impact	3	3	4	4	4	4	3
Landscape Impact	5	5	3	3	2	3	5
Environmental Impact	4	4	4	3	2	3	4
Indoor Acoustical Impact	3	3	4	4	4	4	3
Outdoor Acoustical Impact	5	5	3	3	3	3	5
System Installation Flexibility	5	5	3	3	3	3	5
System Operating Flexibility	5	5	3	3	3	2	5
Level of Complexity	4	4	3	2	1	1	4
Degree of Control of Interior Conditions	4	4	4	4	4	4	4
Fire Safety	4	5	4	2	3	2	5
Water Damage Potential	4	4	4	4	4	4	4
Emergency Generation Load	1	3	1	3	3	4	3
Total Point Values	51	54	43	40	37	38	53

Since the comparison criteria presented above are mainly subjective in nature, the rationale for the selection of "point" values for each system is presented below to clarify the decision making process:

System 4 - Package air conditioners with water-cooled condensers, electric resistance heat, and electric (electrode boiler type) humidifiers.

This system will consist of air conditioning units that are similar to the unit that the Castle staff implemented in a selected area of the Castle during the summer and fall of 1990. These units will be fully self-contained and portable, but will require ductwork routed to grilles and registers in the conditioned spaces, which will require some cutting and patching. Services required to each unit will be cooling water supply (which will also serve as water supply to the humidifiers), waste water drain (cooling water and condensate), and electrical connections. These services will take up little space and should require little cutting and patching, especially if the units are located in the Main House Basement and Annex first floor areas. **Assign a value of 4 to System Installation Impact.**

It will be possible to locate most of these air conditioning units in the basement of the Main House, closets, and first floor service areas in the Annex. However, some of the units may have to be located directly in the space that they serve. This will introduce a direct intrusion on the historical scene in some of the areas of the Castle. **Assign a value of 3 to Interior Historical Scene Impact.**

This system will have no effect on the landscape surrounding the Castle, since all of the system components will be contained within the Castle proper. **Assign a value of 5 to Landscape Impact.**

This system will have little or no effect on the immediate Castle environment, since it is all electric. **Assign a value of 4 to Environmental Impact.**

Since each individual unit has its own compressor, and since the units are to be installed inside of the building, there is a potential for an interior noise problem. The park staff has indicated that the unit that they implemented in 1990-91 was fairly quiet while operating. **Assign a value of 3 to Indoor Acoustical Impact.**

This system will have no effect on the outdoor acoustics at the Castle, since all of the system components will be contained within the Castle proper. **Assign a value of 5 to Outdoor Acoustical Impact.**

Since this system will use self-contained units, the system installation flexibility will be good. Individual units may be installed as funding allows, offering some latitude in fiscal planning. Also, with individual portable units, minimal ductwork, and the lack of large central equipment, the majority of this system will lend itself well to installation by the park maintenance staff. **Assign a value of 5 to System Installation Flexibility.**

This system has a distinct operating advantage over a central system in that if one unit fails, the remainder of the units can remain in service. If any of the central equipment in a central system fails, the entire system may go out of service. Also, with portable units, a failed unit can be disconnected and a spare quickly put in its place. The defective unit can then be repaired or replaced when the maintenance staff has an opportunity to do so. **Assign a value of 5 to System Operating Flexibility.**

The level of complexity of this system is fairly low. There will be no water pumps if gravity water flow is available, and all of the units will be identical in their configuration and operation. The unit controls will be integral with the units, with only the thermostat and humidistat located remotely. Repair of these units should be no more difficult than any of the other existing air conditioning units at the Castle site. **Assign a value of 4 to Level of Complexity.**

Since the heating and cooling functions for the air conditioning units will be independent of each other, there is the potential of adding dehumidification capability by modifying the controls on the units and using the electric coils or recovered heat for reheating the air. This would give complete control of temperature and humidity to the system. However, doing this has some drawbacks as outlined in the analysis discussion above - increased electrical energy consumption and increased electrical service size to handle simultaneous heating and cooling operation (without heat recovery), and increased system cost and complexity. Without dehumidification capability, all of the systems

examined in this comparison will deliver approximately the same level of control over interior conditions. **Assign a value of 4 to Degree of Control of Interior Conditions.**

Fire safety for this system will be good since it is all electric. There is increased potential for fire because of the direct resistance heating elements that will be present in each unit and the increased size of the electrical service necessary to feed them. However, properly sized overcurrent devices and properly functioning hi-limit thermostats will reduce the probability of an electrically induced fire to a very small value. **Assign a value of 4 to Fire Safety.**

There is a potential for water damage associated with all of the systems that have been analyzed in this document. However, this particular system should have somewhat less of a water damage potential since it will be equipped with a drainage system for spent cooling water from the condenser and condensate from the cooling coil. This same drainage system will provide some degree of protection in the event of a valve, humidifier, or piping failure in one of the units. Also, locating the units in the basement of the Main House and first floor areas of the Annex will mitigate the water damage potential. **Assign a value of 4 to Water Damage Potential.**

Maximum demand load for this system will be approximately 140 KW¹²¹ in the heating season. If it is desired that the climate control system continue to operate in the event of power failure, the emergency generation system will have to be sized to carry this load. **Assign a value of 1 to Emergency Generation Load.**

System 5 - Package water source heat pumps with electric (electrode boiler type) humidifiers.

The rationale and point values for all of the criteria except Fire Safety and Emergency Generation Load are the same as for System 4 above since the heat pumps used in this system will be similar to the air conditioning units used in System 4.

Fire safety should be very good since the system is all electric and there will be no direct resistance heating coils in the heat pump units. **Assign a value of 5 to Fire Safety.**

Maximum demand for this system will be approximately 85 KW in the heating season. If it is desired that the climate control system continue to operate in the event of power failure, the emergency generation system will have to be sized to carry this load. **Assign a value of 3 to Emergency Generation Load.**

System 6 - Central air-cooled chiller with fan-coil units, electric resistance heat, and central electric humidification system.

This system will consist of a 55 nominal ton¹²² capacity (13'-4" L x 7'-0" W x 5'-8" H) package air-cooled chiller with remote fan-coil units. Services required to each fan-coil unit will be chilled water supply and return, low pressure humidifier steam, condensate drain, and electrical connections. In addition, the fan-coil units would be permanently

121. Kilowatts

122. 1 ton = 12,000 BTU (British Thermal Units) per hour cooling capacity

installed in concealed locations with ductwork routed to grilles and registers in the conditioned spaces. This system may require considerable cutting and patching to install. **Assign a value of 3 to System Installation Impact.**

Since the fan-coil units will be installed in concealed locations, the major intrusions on the historical scene will be the registers and grilles necessary for air distribution in the spaces, and any access panels or doors that might be necessary to service the units. **Assign a value of 4 to Historical Scene Impact.**

The proposed location for the installation of the air-cooled chiller unit is at the south end of the tunnel that runs between the east and west portions of the Swimming Pool. The installation of this unit will require a substantial retaining wall and may or may not be visible from the parking lot or the Castle. The park staff has also indicated that the end of the tunnel may be included on interpretive tours in the future and that the proposed chiller site also falls into the 100 year maximum flood plain. **Assign a value of 3 to Landscape Impact.**

This system will have little or no effect on the immediate Castle environment, since it is all electric. **Assign a value of 4 to Environmental Impact.**

Most of the fan noise generated by the fan-coil units will be attenuated in the ductwork. Fan-coil units in the size ranges necessary for this application are typically fairly quiet, even without ductwork. **Assign a value of 4 to Indoor Acoustical Impact.**

Since the air-cooled chiller unit will be installed outdoors, there will be some noise associated with its operation. **Assign a value of 3 to Outdoor Acoustical Impact.**

Although the park staff may be able to install the individual fan-coil units, their appurtenant ducts, piping, and electrical feeders, and the central equipment (chiller, chilled water pumps, expansion tank, etc.) would probably have to be installed by a contractor. **Assign a value of 3 to System Installation Flexibility.**

Since this is a central system, failure of the chiller or any other piece of central equipment may cause the entire system to go out of service. Also, with permanently installed fan-coil units, the units would have to be repaired in place. **Assign a value of 3 to System Operating Flexibility.**

The level of complexity of this system is fairly high. In addition to the central chiller and its controls, there will be chilled water pumps and a chilled water loop to maintain. **Assign a value of 3 to Level of Complexity.**

Again, without dehumidification capability, the degree of control of interior conditions will be approximately the same for all of the comprehensive climate control systems analyzed. **Assign a value of 4 to Degree of Control of Interior Conditions.**

Fire safety for this system will be good since it is all electric. There is increased potential for fire because of the direct resistance heating elements that will be present in each unit and the increased size of the electrical service necessary to feed them. However, properly sized overcurrent devices and properly functioning hi-limit thermostats will reduce the probability of an electrically induced fire to a very small value. **Assign a value of 4 to Fire Safety.**

The potential for water damage with this system should be no greater than that of Systems 4 and 5 since most of the units can be installed in the basement of the Main House and first floor areas of the Annex. **Assign a value of 4 to Water Damage Potential.**

Maximum demand load for this system will be approximately 140 KW in the heating season. If it is desired that the climate control system continue to operate in the event of power failure, the emergency generation system will have to be sized to carry this load. **Assign a value of 1 to Emergency Generation Load.**

System 7 - Central air-cooled chiller with fan-coil units, propane gas-fired hydronic heat, and central propane gas-fired humidification system.

The rationale and point values for all of the criteria except System Installation Impact, Environmental Impact, Level of Complexity, Fire Safety, and Emergency Generation Load are the same as for System 6 above since the chilled water system used in this system will be the same as that used in System 6.

This system will consist of a 55 nominal ton capacity (13'-4" L x 7'-0" W x 5'-8" H) package air-cooled chiller with remote fan-coil units. In addition, there will be propane gas-fired modular boilers (460 MBH¹²³ gross output, 400 MBH net output total) to provide hot water for space heating. Services required to each fan-coil unit will be chilled water supply and return, hot water supply and return, low pressure humidifier steam, condensate drain, and electrical connections. In addition, the fan-coil units would be permanently installed in concealed locations with ductwork routed to grilles and registers in the conditioned spaces. This system will require more cutting and patching to install than System 6 and will require space for the boilers. **Assign a value of 2 to System Installation Impact.**

There may be some impact on the immediate Castle environment due to the emissions from the boilers. Because the boilers specified would be high efficiency units meeting the air pollution requirements of the State of California, these emissions should be minimal. **Assign a value of 3 to Environmental Impact.**

Because of the addition of the boilers, hot water pumps, and hot water loop, this system will have a higher level of complexity than System 6. **Assign a value of 2 to Level of Complexity.**

Fire safety for this system will be decreased because of the addition of propane gas-fired boiler equipment. The potential fire hazard may increase or decrease depending on the final location chosen for this equipment. Locating the boilers in the basement of the Main House is prohibited by code (Uniform Mechanical Code Section 504(f)) unless provision is made for the removal of unburned propane gases (gravity or mechanical venting). The only other place to locate the boilers would be in the tunnels somewhere outside of the Main House basement, reducing the potential fire hazard somewhat. **Assign a value of 2 to Fire Safety.**

123. 1 MBH = 1000 BTU (British Thermal Units) per hour heating capacity

Maximum demand load for this system will be approximately 80 KW in the cooling season. If it is desired that the climate control system continue to operate in the event of power failure, the emergency generation system will have to be sized to carry this load. **Assign a value of 3 to Emergency Generation Load.**

System 8 - Central air-cooled chiller with fan-coil units, oil-fired hydronic heat, and central oil-fired humidification system (includes new underground fuel oil storage tank, leak monitoring system, and spill prevention appurtenances).

The rationale and point values for all of the criteria except System Installation Impact, Landscape Impact, Environmental Impact, Level of Complexity, and Fire Safety are the same as for System 7 above since the chilled water and heating systems used in this system will be similar to those used in System 7.

This system will consist of a 55 nominal ton capacity (13'-4" L x 7'-0" W x 5'-8" H) package air-cooled chiller with remote fan-coil units. In addition, there will be oil-fired modular boilers (460 MBH gross output, 400 MBH net output total) to provide hot water for space heating, a day tank with fuel pump, and a new underground fuel oil storage tank, leak monitoring system, and spill prevention appurtenances. Services required to each fan-coil unit will be chilled water supply and return, hot water supply and return, low pressure humidifier steam, condensate drain, and electrical connections. In addition, the fan-coil units would be permanently installed in concealed locations with ductwork routed to grilles and registers in the conditioned spaces. This system will require more cutting and patching to install than System 6, and will require space for the boilers and the new underground fuel oil storage tank. **Assign a value of 1 to System Installation Impact.**

In addition to the outdoor space required for the chiller unit, a site on the Castle grounds would have to be located for the installation of a new underground fuel oil storage tank. This site would need to be accessible to the fuel oil supplier's delivery truck for filling. **Assign a value of 2 to Landscape Impact.**

There may be some impact on the immediate Castle environment due to the emissions from the boilers. Because the boilers specified would be high efficiency units meeting the air pollution requirements of the State of California, these emissions should be minimal. There is also the potential for fuel oil leakage underground (very minimal with a double-walled tank, double-walled piping, and continuous leak monitoring) or fuel oil leakage inside the Castle basement. **Assign a value of 2 to Environmental Impact.**

Because of the addition of the fuel oil storage and delivery equipment, this system will have a higher level of complexity than System 7. **Assign a value of 1 to Level of Complexity.**

Fire safety for this system will be decreased because of the addition of oil-fired boiler equipment. The potential fire hazard may increase or decrease depending on the final location chosen for this equipment. Locating the boilers in the basement of the Main House similar to the existing boiler should not increase the fire hazard above that of the existing situation. **Assign a value of 3 to Fire Safety.**

System 9 - System 7 above with ice storage for peak load shaving.

The rationale and point values for all of the criteria except System Installation Impact, System Operating Flexibility, Level of Complexity, Water Damage Potential, and Emergency Generation Load are the same as for System 7 above since the chiller and heating equipment used in this system will be similar to those used in System 7.

The major differences between this system and System 7 are the addition of ice storage units (three 90 ton-hour¹²⁴ units at 6'-10" H x 6'-2" Dia.), an ethylene glycol solution loop, glycol solution pumps, glycol solution heat exchanger, glycol solution makeup system, and downsizing of the chiller from 55 nominal ton capacity to 35 nominal ton capacity (14'-6" L x 5'-9" W x 4'-4" H). In all other aspects, the systems are the same. This system will require additional space somewhere in the basement of the Main House for the ice storage units and glycol solution pumps, piping, and appurtenances. **Assign a value of 1 to System Installation Impact.**

The addition of the glycol loop and its associated equipment to the System 7 configuration represent more components with the potential for failure that would cause the entire cooling system to go out of service. **Assign a value of 2 to System Operating Flexibility.**

Because of the addition of the glycol loop, associated equipment, and ice storage modules, the complexity of this system will be higher than that of any of the other systems analyzed in this document. **Assign a value of 1 to Level of Complexity.**

Even with the addition of the glycol loop and ice storage modules, the water damage potential for this system should be no greater than that of System 7. The reason for this is that the heat absorbed by the chilled water contained in the chilled water loop extending throughout the Castle will be transferred into the glycol solution through a heat exchanger in the basement. All of the glycol solution piping will be isolated in the basement; any glycol solution leakage will affect only the basement mechanical areas, not the remainder of the Castle. **Assign a value of 4 to Water Damage Potential.**

Maximum demand load for this system will be approximately 60 KW in the cooling season due to the downsizing of the chiller unit. If it is desired that the climate control system continue to operate in the event of power failure, the emergency generation system will have to be sized to carry this load. **Assign a value of 4 to Emergency Generation Load.**

System 10 - System 5 above with improvements to the building envelope.

The rationale and point values for all of the criteria except System Installation Impact are the same as for System 5 above since the system used here will be identical to System 5 with the exception of improvements to the building envelope.

Improvements to the building Envelope as described in Interim Treatments above will represent an additional impact to the Castle fabric above that of the climate control system installation. **Assign a value of 3 to System Installation Impact.**

124. 1 Ton-Hour = 12,000 BTU (British Thermal Units)

Recommended Treatments and Systems

Existing Building Treatments. The recommended existing building treatments will be enumerated here with the intent being to coordinate these treatments with the installation of the comprehensive climate control system.

Building Envelope Improvements. Since this treatment will improve control of interior climate conditions, reduce dust infiltration, increase fire safety, and reduce energy consumption, it is highly recommended to be implemented. This treatment represents a savings in annual operating and maintenance expenses of \$2,586 for System 10 versus System 5 and can be implemented at any time before or during the comprehensive climate control system installation.

Improvements to Existing Heating System. The main improvement to the existing heating system that needs to be implemented as soon as possible is the addition of an emergency boiler shutdown switch. Depending on the length of time that it takes to complete the installation of a comprehensive climate control system, the other recommended improvements to the existing heating system may or may not be necessary to improve its performance and reliability. The major emphasis should be to completely deactivate the existing system as soon as possible to preclude further damage to the building fabric and furnishings from leaking pipes and fuel oil contamination.

Fountain Rehabilitation and Reactivation. The rehabilitation and reactivation of the fountains is recommended here only as it relates to recreating or enhancing the historic scene. As discussed in Treatments above, the fountains should not be reactivated solely for humidification purposes if a comprehensive climate control system is going to be implemented.

Shading. Reconstruction of external shading devices such as the eucalyptus log arbor over the central patio or the Lanai is recommended here only as it relates to recreating or enhancing the historic scene. As discussed in Treatments above, the overall shading effect of these devices is small and will reduce the total air conditioning load only slightly. Closing the operable shutters on the exterior windows that have them is probably the most effective way to reduce heat gain to the building interiors in the hotter parts of the year, and is recommended to be done if it does not conflict with interpretive or preservation goals.

Comprehensive Climate Control System. An examination of the "Alternative Climate Control System Costs" matrix presented above shows that although System 10 has a higher installation cost than System 5 due to the cost for making improvements to the building envelopes, System 10 has a lower operating cost and more importantly, a lower life cycle cost than any of the other comprehensive climate control systems studied. Looking at the "Comprehensive Climate Control System Comparison" matrix presented above shows System 5 with the highest score for the subjective criteria and System 10 with the second highest score, again due to the impact caused by improving the building envelopes.

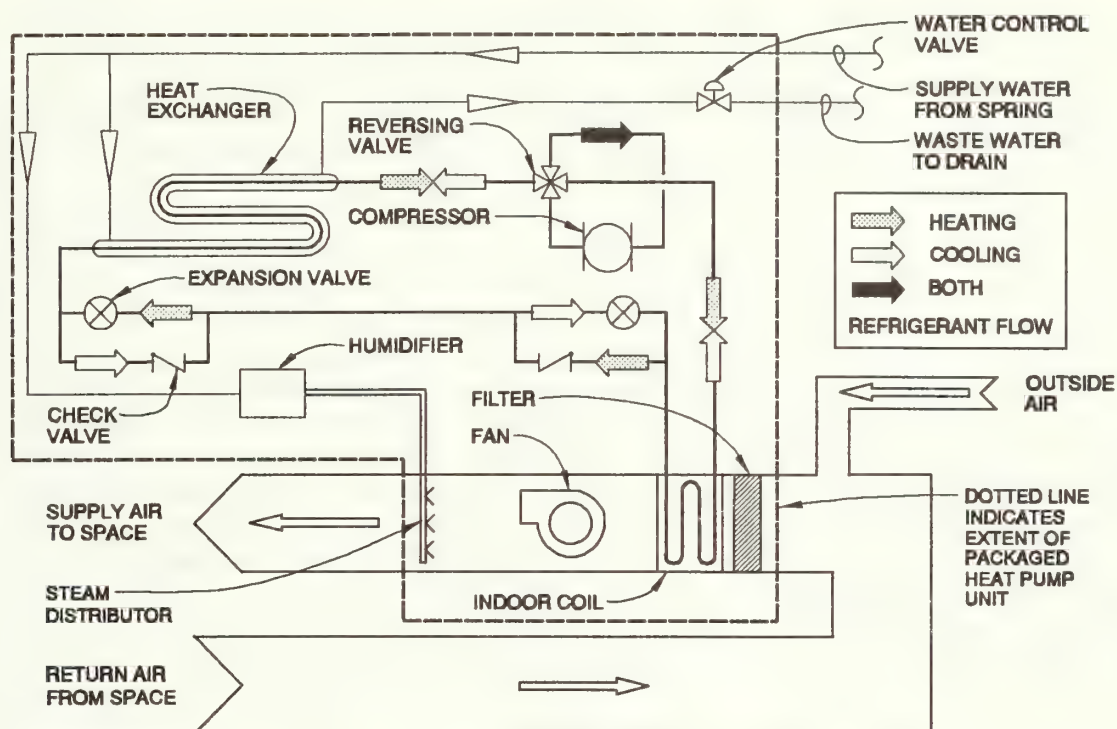
Based on the criteria discussed above, the system recommended for implementation for comprehensive climate control is System 10, package water source heat pumps with electric (electrode boiler type) humidifiers implemented concurrently with the existing building treatment of improvements to the building envelope. Individual water source heat pump units would be installed in various zones in the Castle, and would be connected to a central spring-supplied water piping system to provide a heat source/heat sink for the individual units. The water for humidification would be supplied by this same piping system and would be treated

by a water softening system to reduce humidifier maintenance. Water from the central water system would be supplied to each heat pump unit and then discharged to drain. Approximately 80 gallons of water per minute (2-inch to 2-1/2-inch main supply pipe size) will be required at peak design conditions. Temperature measurements by the park staff have shown that the temperature of the spring water varies in the range of 68 to 80 degrees, winter to summer. This range is quite acceptable for the operation of the heat pump units.

Some of the major desirable features of the recommended system will be reiterated and expanded upon here. First, given the nature of the funding that will be likely to be available for this type of project (smaller amounts over a period of years), this system lends itself well to being installed in pieces. Since each individual zone unit is self-contained and can stand alone, the zones that equipment is installed in will be completely functional. Second, because each piece of equipment will be a package with all functions integrated in it, the only connections that need to be made to make each unit functional are electrical service, water service, and a gravity drain. This should make it possible for the majority of the system installation to be performed by the park maintenance staff, who have demonstrated themselves capable of similar work in the past. Third, since the system is not dependent on central heating or refrigeration equipment for its operation, failure of any unit in the system will not affect the operation of the other units in the system. One spare unit of each size could be kept on hand in case of failure, and the failed unit could be quickly replaced with a spare and then be serviced properly in the maintenance shop. Units could be moved in and out of the Main House basement by building a removable ramp on the stairs leading out of the basement into the tunnel that runs between the two portions of the swimming pool. The units could be laid on their sides on a wheeled dolly built for the purpose and winched up or down the ramp on the stairs. By rolling the units down the tunnel, they could be loaded into a truck at the end of the tunnel and taken in the truck to be serviced. After moving operations were completed, the ramp could be removed and stored until it was needed again. Units in the Annex can be directly rolled out into a waiting truck due to the location of the units on the first floor of the Annex. Protection should be provided on any finished floors or surfaces where the units may be rolled.

A routine maintenance program should be implemented once the climate control system is in place and operating. This program should include routine monitoring of heat pump unit components and functions, filter changes, condensate drain pan cleaning and checking, and humidifier maintenance. Monitoring of interior space conditions with the hygrothermographs should be continued to monitor proper climate control system operation. Consideration should be given to installing an electronic monitoring system in the future to centralize and simplify space condition data gathering and processing. This system could be expanded to include automatic control of the heat pumps, and monitoring and control of intrusion and fire alarm systems, all from a central location.

Recommended System Operation Description. The operation of the heat pump units will be described here. A schematic diagram has been included to clarify the operation description. This diagram represents one unit for one zone only; the entire system will consist of several of these units connected to a common water supply and waste water drainage system. Various items necessary for the actual operation of the system such as filter-driers, suction accumulators, dampers, grilles, controls, etc. have not been shown to simplify the following discussion.



WATER SOURCE HEAT PUMP SCHEMATIC

Figure 1: Water Source Heat Pump Schematic

Cooling Mode. Starting at the compressor, the refrigerant (in this case, HCFC-22 or R-22) is directed through the reversing valve toward the heat exchanger; at this point the refrigerant is at high pressure in a gaseous state. As the refrigerant travels through the heat exchanger, heat from the space and heat from the compressor is transferred into the water flowing through the shell of the heat exchanger, raising the temperature of the water. The refrigerant condenses into a liquid state, and by the time it reaches the end of the heat exchanger, all of the refrigerant will have been condensed. A water control valve on the outlet side of the heat exchanger controls the flow rate of the water to maintain proper water temperature. The refrigerant then bypasses the first expansion valve through a check valve and continues on to the second expansion valve. At the second expansion valve, the refrigerant is forced to flow through the expansion valve by the check valve at that location. The expansion valve reduces the pressure of the liquid refrigerant; this allows the refrigerant to boil at a much lower temperature. The low pressure liquid refrigerant then continues on into the indoor coil where heat from the space is transferred from the air flowing through the coil into the refrigerant, lowering the temperature of the air. The refrigerant boils and returns to a gaseous state, and by the time it reaches the end of the indoor coil, all of the refrigerant will have been boiled off. From here the refrigerant travels back to the reversing valve, where it is directed into the suction side of the compressor to repeat the cycle. A thermostat located in the conditioned space cycles the compressor on and off as cooling is required.

Heating Mode. When the thermostat located in the conditioned space determines that heating is required, it energizes the reversing valve and the compressor. By energizing the reversing

valve, the flow of refrigerant is redirected such that it flows in a reverse direction through the system. The operation of the unit is the same as described above, except that in the heating mode, heat is transferred out of the refrigerant into the air flowing through the indoor coil, raising the temperature of the air, and heat is transferred out of the water in the heat exchanger into the refrigerant, lowering the temperature of the water. The space thermostat cycles the compressor and reversing valve on and off as heating is required.

Ventilation and Humidification. Air passing through the unit is either cooled or heated by the indoor coil, depending on the space temperature requirements. The unit fan pulls the air through the coil and discharges it into supply ductwork connected to grilles or other openings in the conditioned space. Downstream of the fan is a steam distributor that allows steam generated in the humidifier to be introduced into the airstream through small nozzles in the distributor. A humidistat located in the conditioned space cycles the humidifier on and off as humidification is required. Although the schematic diagram presented here shows the humidifier water supply taken directly from the heat pump supply piping, in practice the humidifier supply water will be taken from a softened water source to reduce humidifier maintenance. Return air from the conditioned space is mixed with outside air and is pulled through an air filter back to the indoor coil to repeat the cycle. The outside air (not more than 10 percent of the total supply airflow) provides ventilation for occupants of the space, and also pressurizes the space with respect to the outdoors, reducing uncontrolled air and dust infiltration from the outdoors.

Impacts

Various impacts to the building fabric, park operations, and the Castle development infrastructure caused by the installation of the recommended comprehensive climate control system will be discussed below.

Impacts to Building Fabric. The magnitude of the impact to the building itself will depend mainly on the final form that the system takes. At present it appears that all of the heat pumps required for the climate control system can be located in the Main House basement or in first floor areas of the Annex. Most of the ductwork required will penetrate finished floors, necessitating removal of floor tiles. It is recommended that radiographs (x-ray images) of the floors be taken where penetrations are planned to occur. This will allow visualization of conduit, piping, or other services embedded in the slab so that they can be avoided in the penetration. Other penetrations will be required for water, drainage, and electrical services, but will be confined mainly to the Main House basement, service tunnels, and service areas on the first floor of the Annex. It is not anticipated at this time that any of the impacts caused by the installation of the heat pump based climate control system will be irreversible. As to the true extent of the installation impact, this can only be determined during the actual design of the system.

Increase in Operating Costs. The importance of operating costs to the overall success of implementing a comprehensive climate control system cannot be underestimated. The installation of System 10, the most economical of the comprehensive climate control systems studied, represents a 285 percent increase in annual energy cost over the existing situation. Also, maintenance costs will increase. Routine maintenance such as filter changes and humidifier servicing will be required in addition to periodic monitoring of the equipment for proper operation and in addition to major repairs as they become necessary. If increased annual operating funds are not made available for the operation and maintenance of this type of system, problems will arise when the park staff tries to bring the system "on line". The best climate

control system in the world will not function properly if funds are not forthcoming to operate and maintain it properly.

Emergency Generation Capability. If continuous, uninterrupted operation of the climate control system is desired, an emergency generation system with a capacity large enough to handle approximately 85 KW (the majority of which is motor load) will have to be provided. This issue is discussed in more detail in the Electrical System Assessment chapter of this Historic Structure Report.

Water Supply. As stated above, the heat pump units will require approximately 80 GPM (gallons per minute) of water at peak design conditions. The park staff has indicated that the maximum flow rate for the spring feeding the development is 190 GPM. They have also indicated that typically when the Pelton wheel generator for the night lighting at the Castle is operated (approximately 185 GPM flow rate), the 40,000 gallon reservoir is drawn down to one third to one half of its capacity by morning when the Pelton wheel is shut down. This indicates that the spring usually cannot meet a 185 GPM demand, let alone another 80 GPM on top of that demand. It must be kept in mind, however, that the 80 GPM required by the heat pump system is a peak flow rate and will occur only on the very coldest and hottest days of the year. At all other times, the flow will be a fraction of the peak flow; in the spring and fall there will be times when there will be no water flowing through the heat pumps. Even so, a shortage of water may prove to be a problem in the future.

This problem may be solved in several ways. One solution (which has been studied before) would be to develop undeveloped springs in the area to increase the water flow rate.¹²⁵ Another solution would be to take water from the Pelton wheel discharge and/or the overflow from the reservoir that feeds the stream through the development, and pressurize it with a hydropneumatic system so that the heat pump system always has that portion of the water flow that is not being used in the site plumbing or irrigation systems for its use. Both of these solutions will increase the cost of the basic system. Pressurizing the Pelton wheel discharge will increase the operating cost of the system due to the pumping energy required. A third solution would be to limit the use of the Pelton wheel during peak heating and cooling seasons to keep the reservoir level up. Presently the Pelton wheel is turned on and off at fixed times by the Castle staff which does not take into account the variation of dawn and dusk with the seasons. Addition of an automatic on/off control valve with an astronomical timer would save a considerable amount of water. If water levels are still below acceptable limits in the peak heating and cooling seasons, the Pelton wheel may have to be shut off completely. This is the most economical solution and would only require monitoring the reservoir level on a regular basis.

If for some reasons none of the solutions presented above prove feasible, a ground-coupled heat pump system could be implemented. This would consist of several wells drilled on the Castle site. Pairs of polyethylene pipes with return bends at the bottom would be inserted into the wells and all of the well piping would be connected in parallel. Water would then be circulated through the piping in the wells, then through the heat pumps, and back to the wells again in a closed loop, transferring heat into or out of the earth. The major drawbacks of this type of system are the increase in installation cost, increased maintenance in the form of the closed water loop and pumps, and the impact of drilling wells somewhere on the site (the location of the wells is not extremely critical since they do not need to be water wells). The advantages of this

125. Beamer/Wilkinson and Associates. "Engineer's Report, Survey and Investigation of Utility Systems, Death Valley Ranch, Scotty's Castle" (November 1973).

type of system is that the water is in a closed loop and can be easily treated to mitigate fouling of the heat pump water-to-refrigerant heat exchangers, and that no additional energy input other than that needed for pumping the water through the loop is required.

The total predicted water usages for the heat pump system are as follows:

Cooling Mode	1,730,775 Gallons per Year
Heating Mode	1,330,840 " " "
Humidification	<u>17,537</u> " " "
Total	3,079,150 Gallons per Year

The temperature of the water passing through the system will be changed by the operation of the heat pumps. These temperature changes will be in the range of a 20 degree F increase in the inlet water temperature at peak cooling conditions and a 15 degree decrease in the inlet water temperature at peak heating conditions. The discharge water from the climate control system is planned to be routed into the same drainage pipe that handles the discharge from the Pelton wheel. This pipe terminates in the vicinity of the historic entrance gate and its discharge mixes with the flows from the picnic area stream (100 GPM from a separate source) and the watercourse (25 GPM from the main spring). From there, all flows continue into a pond behind the historic entrance gate. The pond overflow dissipates by evaporation and by disappearing into the ground in a heavily overgrown area downstream of the pond. Mixing the peak 80 GPM flow from the climate control system with 125 GPM from the picnic area stream and watercourse will attenuate the temperature increase/decrease caused by the operation of the heat pumps. The park resources staff has also indicated that there are no significant life forms present in the pond that may be adversely affected by any water temperature changes.

In addition, although the spring water available at the Castle has a high mineral content, the park staff has indicated that concessioner's refrigerating units at the site with water-cooled condensers have been in operation for 10 to 15 years with no major heat exchanger fouling. This would appear to indicate the spring water at the site should be suitable for heat transfer purposes without fouling the heat pump water-to-refrigerant heat exchangers.

Recommended Treatment and System Implementation Methodology

Park staff day labor installation of portions of the treatments and systems has been mentioned in previous chapters. A more thorough discussion of this subject will be presented here along with a chronology as a recommended guide to the implementation of the interim treatments and the final climate control system.

Day Labor Treatment and System Installation. There are several distinct advantages that can be realized by having the park maintenance staff perform most of the work required for installing the recommended treatments and the recommended comprehensive climate control system using day labor in lieu of having this work done by contractors. These advantages are enumerated below.

Since the people in the Service Center and the Regional Office responsible for funding, design, project supervision, and procurement for these projects will be in close contact with and will be familiar with the park personnel who will actually be doing the work, a close working relationship can be developed if day labor is employed. A close working relationship will be essential on a historical job like this where the design may have to be changed as the work

progresses due to differing conditions. If these projects are advertised and contractors are hired to do the work, the close working relationship will be lost. Because of the low-bid scenario in which contracts are typically awarded, there will be very little control over the selection of the contractors. This will result in a possibility of getting contractors who are difficult to work with. Also, if contractors are employed, any changes that need to be made in the design as the work progresses will result in modifications with attendant increases in the cost of the project.

The park staff possesses a sensitivity to and a familiarity with the requirements of this particular building that a contractor will not have. They have had experience with the various finishes and construction techniques that were used in the Castle and can foresee what will be necessary where a penetration needs to be made, or a finish needs to be restored after a pipe or piece of equipment is installed. A contractor will probably not have this sensitivity to the building and will require much more supervision and guidance.

Substantial cost savings can be realized by having the park staff perform the work by avoiding the inevitable overhead and profit, and remote site costs that will be charged by a contractor. Markups of 25 percent for overhead and profit, and 30 percent for remote site were used in the analyses in the treatment discussion. This represents an effective increase in cost of construction of 62.5 percent over the bare labor and material costs required. In the case of System 10 this reduces the installation cost from \$300,174 that would need to be allocated for a contract to \$184,722 that would need to be allocated for day labor. Further savings may be realized due to the park's ability to procure materials and equipment on GSA Schedule. This method of procurement has the added benefit of allowing the designer to specify the exact materials and equipment needed for the job without concern that a contractor will substitute an "equal". Because the work will probably be split up and done in phases, due to the nature of the funding available, additional funds can be saved by avoiding NPS contracting overhead costs and contractor's mobilization costs that will be associated with each contract.

Because of the lack of large central equipment, the recommended comprehensive climate control system lends itself well to installation by the park staff. The packaged nature of the heat pump equipment will make the piping and electrical services for the heat pumps the majority of the work that will be required. The recommended existing building treatments also appear to be within the capabilities of the park staff. The park staff has demonstrated in the past that they are capable of performing these levels of work as evidenced by the Castle rewiring, fire alarm system installation, piping work in the Castle basement, repairs and renovation of the steam heating system, architectural renovation and preservation, and various other related work that they have performed in the Castle. Ductwork fabrication and installation is probably the only portion of the work that will need to be contracted out.

Treatment and System Implementation Chronology. Due to the failure of the steam pipe in the Kitchen wall in 1991, and the potential for further damage from steam pipe leakage in other areas of the Castle, it is recommended that the design and installation of a comprehensive climate control system proceed as soon as possible. The building envelope improvements should be implemented at the same time.

Fiscal Year 1992. Provide designs for improvements to the building envelope and the existing heating system. Begin installation of comprehensive climate control system and building envelope improvements.

Fiscal Year 1993 and Beyond. Continue installation of comprehensive climate control system and building envelope improvements as funding allows, until completion is realized.

Annual Temperature and Relative Humidity Data Listing, Maximums and Minimums for All Areas, 1988.¹²⁶

Area No.	Area	Annual Maximum Indoor Temp.(F)	Annual Minimum Indoor Temp.(F)	Annual Maximum Daily Temp. Swing(F)	Annual Maximum Indoor R.H.(%)
1	Solarium	94	49	11	80
2	Scotty's Bedroom	89	48	9	71
3	Living Hall	94	50	9	63
4	Gallery	95	50	11	64
5	Living Hall Beams	98	49	13	65
6	Johnson's Bedrooms	95	42	11	67
7	Kitchen	92	49	10	67
8	Dining Room	91	47	10	68
9	Italian Room	92	41	9	62
10	Bokhara Room	96	37	12	78
11	Upper Music Room	97	42	9	73
12	Organ Chambers	102	59	8	44
13	Refrigerator/Freezer	96	50	6	70
14	Basement	93	52	9	100

Area No.	Annual Minimum Indoor R.H.(%)	Annual Maximum Daily R.H. Swing(%)	Annual Maximum Indoor Temp.(F) (W/HVAC)	Annual Minimum Indoor Temp.(F) (W/HVAC)	Annual Maximum Indoor R.H.(%) (W/HVAC)	Annual Minimum Indoor R.H.(%) (W/HVAC)
1	19	38	72	58	40	35
2	17	20	72	58	40	35
3	24	17	72	58	40	35
4	18	17	72	58	40	35
5	11	20	72	58	40	35
6	16	27	72	58	40	35
7	12	33	72	58	40	35
8	24	18	72	58	40	35
9	21	24	72	58	40	35
10	13	21	72	58	40	35
11	20	19	72	58	40	35
12	10	15	72	58	40	35
13	15	13	72	58	40	35
14	6	49	72	58	40	35

126. The data listings presented here are condensed from hygrothermographic temperature and relative humidity readings taken by the park curatorial staff during calendar year 1988. Graphs representing some of this data have also been included below. The legend for these graphs is as follows:

MXI - Maximum Indoor Temperature or Relative Humidity
 MNI - Minimum Indoor Temperature or Relative Humidity
 MXH - Maximum Indoor Temperature or Relative Humidity with Heating, Ventilating, and Air Conditioning
 MNH - Minimum Indoor Temperature or Relative Humidity with Heating, Ventilating, and Air Conditioning
 MXO - Maximum Outdoor Temperature or Relative Humidity
 MNH - Minimum Outdoor Temperature or Relative Humidity

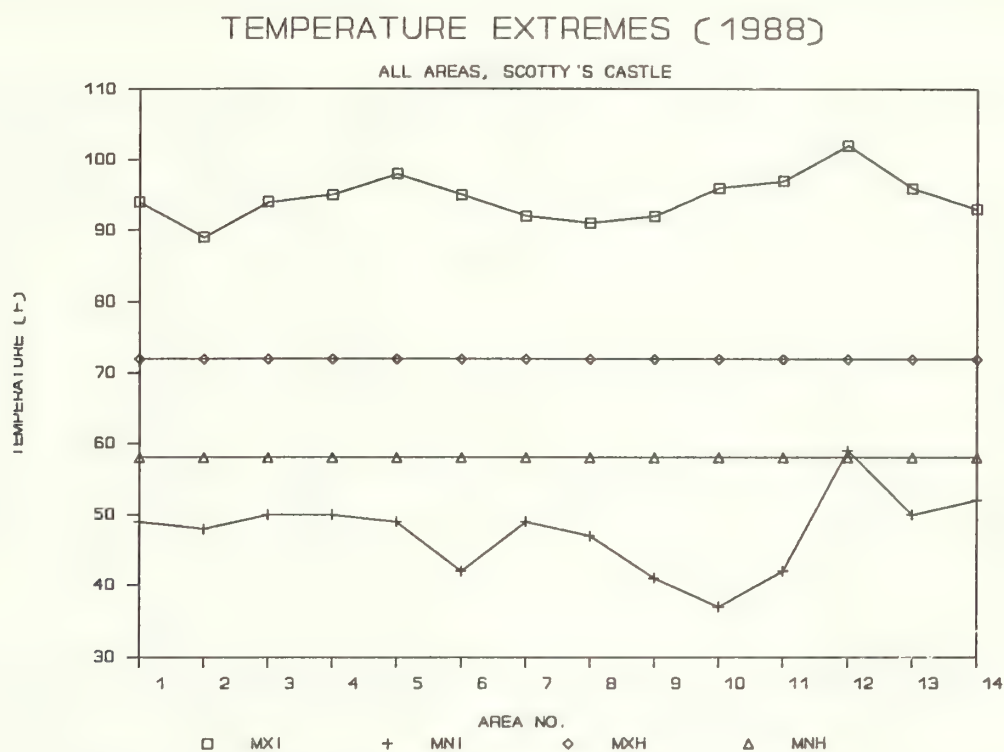


Figure 2: Temperature Extremes, 1988

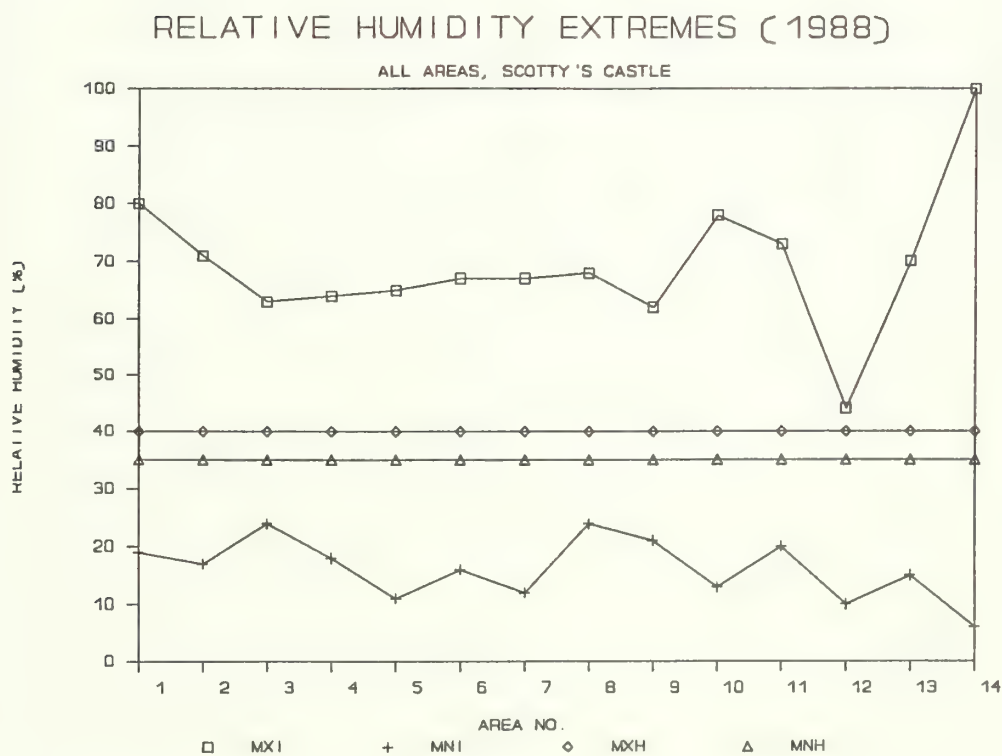


Figure 3: Relative Humidity Extremes, 1988

Temperature and Relative Humidity Data Listing, Maximums and Minimums, Sample Area (Upper Music Room, Area 11).

Month	Monthly Maximum Indoor Temp.(F)	Monthly Minimum Indoor Temp.(F)	Monthly Maximum Indoor R.H.(%)	Monthly Minimum Indoor R.H.(%)	Monthly Maximum Indoor Temp.(F) (W/HVAC)	Monthly Minimum Indoor Temp.(F) (W/HVAC)
Jan.'88	61	42	50	37	62	58
Feb.'88	70	52	73	36	64	60
Mar.'88	76	60	69	31	66	62
Apr.'88	77	66	57	34	68	64
May '88	86	64	51	34	70	66
Jun.'88	92	73	45	26	72	68
Jul.'88	97	85	43	20	72	68
Aug.'88	97	81	46	23	70	66
Sep.'88	94	76	42	27	68	64
Oct.'88	84	72	40	22	66	62
Nov.'88	78	56	43	31	64	60
Dec.'88	65	45	40	29	6258	

Month	Monthly Maximum Indoor R.H.(%)	Monthly Minimum Indoor R.H.(%)	Monthly Maximum Outdoor Temp.(F)	Monthly Minimum Outdoor Temp.(F)	Monthly Maximum Outdoor R.H.(%) (W/HVAC)	Monthly Minimum Outdoor R.H.(%) (W/HVAC)
Jan.'88	40	35	66	28	100	18
Feb.'88	40	35	74	34	100	16
Mar.'88	40	35	83	32	100	18
Apr.'88	40	35	84	40	100	3
May '88	40	35	98	38	100	10
Jun.'88	40	35	100	45	94	5
Jul.'88	40	35	114	66	58	1
Aug.'88	40	35	102	64	85	0
Sep.'88	40	35	101	50	64	0
Oct.'88	40	35	95	54	73	11
Nov.'88	40	35	86	36	94	7
Dec.'88	40	35	72	23	83	0

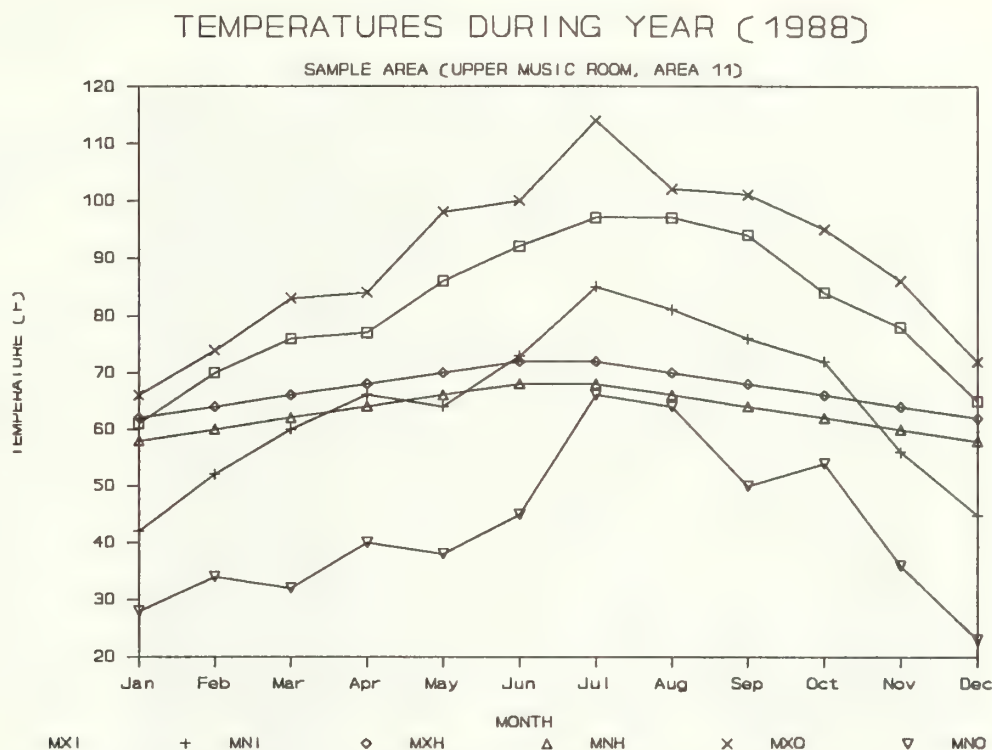


Figure 4: Temperatures During Year, 1988

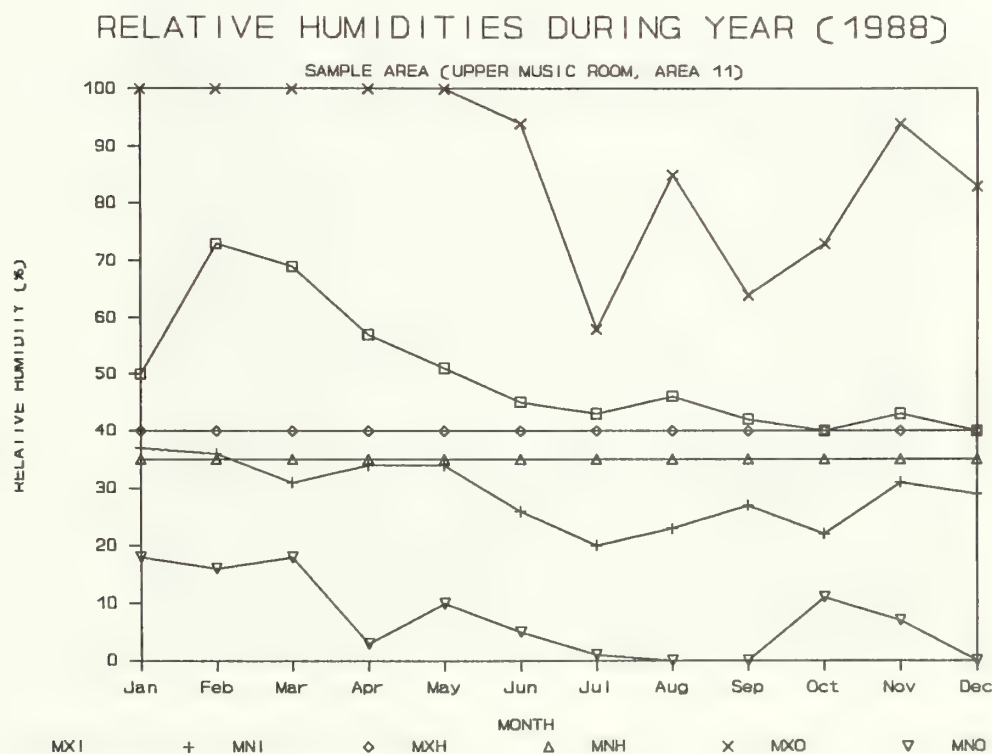


Figure 5: Relative Humidity During Year, 1988



Photo 1: Typical water source heat pump unit for recommended comprehensive climate control system.

FIRE SUPPRESSION SYSTEMS ASSESSMENT

OBJECTIVES

The purpose of this assessment is to document historic fire suppression systems and their current state, and make recommendations for developing a plan for providing an acceptable level of fire protection.

RECOMMENDATIONS SUMMARY

It is recommended that a feasibility study be undertaken to determine whether an automatic fire suppression system can be successfully installed in the Castle buildings with minimal impact to historic fabric and minimal visual intrusion, and to determine the final form that a system should take if feasibility is demonstrated. This study should also include an analysis of the adequacy of the exterior hydrant system and present solutions as necessary.

DOCUMENTATION

An exterior hydrant system for the Castle complex was installed during the original construction of the Castle. Most of the hydrants were located on the grounds around the Castle and the Castle complex buildings; some of the hydrants were mounted directly on the building walls. Many of the original hydrants were located in "Tie Canyon" for the purpose of protecting the railroad ties stored there. Some of the original hydrants have been removed or deactivated due to leakage. During the winter of 1989-90, the hydrant located on the southeast corner of the Annex burst and required replacement.

A new looped piping system with new exterior hydrants and hose houses were installed to protect the Castle and other buildings in the complex in 1982. This work also included improvements to the water supply reservoir, springhouse, and chlorination system.

Dry chemical fire extinguishers have been provided in various areas of the Castle buildings, mainly in closets to conceal them from public view.

ANALYSIS

Although the Main House and Annex are presently equipped with a fire detection system (see Fire Detection System Assessment chapter in this report), no fire suppression systems other than fire extinguishers are installed in the Main House and Annex. The Cookhouse fire in 1991 has renewed interest in the possibility of installing an automatic fire suppression system to protect the Castle buildings and their contents. It is recommended that a feasibility study be done to determine whether a fire suppression system can be successfully installed in these structures with minimal impact to historic fabric and minimal visual intrusion. If a system is determined to be feasible, the design and installation should be closely coordinated with the design and installation of the recommended upgrading and expansion of the existing fire detection system and recommended climate control system.

It does not appear at this time that a fire suppression system that fully conforms to applicable codes for new construction can be installed in the Castle without a great amount of disruption

to the historic fabric and historic scene. Determination of installation feasibility for a fire suppression system will therefore include some equivalency analysis. This will involve studying increased levels of detection, area separations, and fire resistivity of existing construction to provide a level of protection equivalent to or nearly equivalent to that provided by a suppression system that fully meets code.¹²⁷

Halon (halocarbon based extinguishing agent) systems have been considered, but are not recommended because of the ozone depletion potential of halon and the expense of installing and maintaining a halon system for such a large volume of interior space. Halon extinguishing agents are being phased out in accordance with the Montreal Protocol and to present knowledge, no acceptable substitutes have been developed. Also, it is considered good engineering practice to use these types of systems in combination with automatic sprinkler systems, rather than as alternative suppression systems.

It is recommended that the historic hydrants mounted on the exterior surfaces of the Castle structures be deactivated in the future to preclude water damage from leaking pipes or hydrants. This may present some problems, however. The park staff has indicated that the hydrants installed in 1982 taken together with the historic hydrants mounted on the buildings constitute an adequate exterior fire protection system, although the wall mounted hydrants do not meet current codes. If the historic hydrants are deactivated, additional yard hydrants may have to be added to the looped fire protection piping system to achieve an acceptable level of fire protection. This issue should be included in the automatic fire suppression system feasibility study recommended above.

TREATMENT

A practical interior fire suppression system would consist of an automatic fire sprinkler system using water as an extinguishing agent. Design criteria should include concealment of piping wherever possible, selection of sprinklers to minimize visual impact, and minimization of historic fabric removal, cutting, or patching. Some concealed spaces in the buildings may not be accessible for the installation of sprinklers and would not be sprinklered. This type of system can be of several types, depending on whether freezing conditions will be encountered and how protection from leakage and accidental discharge can be effected. The final form that the system would take will be determined in the recommended feasibility study. The feasibility of deactivating the historic wall mounted hydrants and providing additional exterior hydrants will also be determined in the recommended feasibility study.

127. Applicable codes include National Fire Protection Association codes NFPA 911, "Recommended Practice for the Protection of Museums and Museum Collections", NFPA 913, "Protection of Historic Structures and Sites", NFPA 914, "Rehabilitation and Adaptive Reuse of Historic Structures", and California State Historical Building Code.

PLUMBING SYSTEM ASSESSMENT

OBJECTIVES

The purpose of this assessment is to document the historic plumbing system and its current state, and make recommendations for deactivating portions of the system that may cause damage to the historic fabric due to piping failures.

RECOMMENDATIONS SUMMARY

The domestic water piping in the Castle is approaching the end of its useful life and leaks are inevitable. To decrease the damage potential to historic fabric and furnishings it is recommended that all sections of domestic water piping that are not absolutely necessary for park staff operations be deactivated. All waste and soil piping connected to deactivated fixtures and unused floor drains should be plugged or capped to prevent the escape of sewer gas.

DOCUMENTATION

The original plumbing in the Castle consisted of galvanized steel pipe for domestic water and hub-and-spigot cast iron pipe for drain, waste, and vent. The present system has been modified very little and most of the original piping and fixtures are still present in the buildings.

Domestic water heating for the Castle was provided by a solar water heater located northwest of the Annex. The water heater was constructed in 1929 with four collector panels. Four additional panels were added in 1930 to improve the hot water output of the heater. It has been speculated that the heater was used until 1938 when it was damaged and rendered inoperable by severe winter weather. Presently, water heating is provided by an electric water heater located in the tunnels just north of the Main House basement. This heater serves Mrs. Johnson's Apartment in the Annex, the Kitchen and the darkroom in the Main House, and the apartment in the Chimes Tower.

ANALYSIS

Based on past experience, galvanized steel piping used for water service has a limited lifetime, the length of which is generally dictated by the quality of the water carried in the pipe and the environmental conditions present on the exterior surface of the pipe. The exterior surfaces of aboveground domestic water piping in the Main House and Annex appear to be in excellent condition. However, inspection of the interior surfaces of domestic water piping that has been disconnected for one reason or another shows that substantial corrosion and mineral deposition have occurred. Also, piping failures occurred in the steel piping of the steam heating system during the winter of 1990-91, causing significant damage to the historic plaster finish in the Kitchen. Based on these observations, it seems reasonable to assume that it is simply a matter of time until piping failures occur in the domestic water system that may cause irreparable damage to interior finishes and furnishings in the Castle. It is recommended that sections of the plumbing system, other than those sections feeding fixtures in basement or non-critical areas, be deactivated to preclude damage due to piping failures.

TREATMENT

Domestic water supply piping serving fixtures in the following areas of the Castle should be deactivated if they have not already been deactivated:

Main House

- Spanish Suite bathroom
- Service closet adjacent to Spanish Suite
- Johnson Bedroom Suite bathroom
- Bathroom behind fireplace in Living Hall
- Service closet behind Jasper Fountain
- Kitchen

Annex

- Bathroom and kitchen in Mrs. Johnson's Apartment
- Bathroom adjacent to Guest Bedrooms

Chimes Tower

- Apartment

The darkroom fixtures and laundry tub in the basement of the Main House, and the fixtures in the bathroom behind the Commissary in the Annex may remain activated as necessary for park staff operations. These areas have floor drains and painted, hard surface wall and floor finishes (unlike the other areas listed above) and as such are less prone to permanent damage from a piping failure. All other floor drains that may be necessary for the operation of a comprehensive climate control system should remain activated. If any of the floor drains that are to remain in use are clogged, they should be cleaned with power sewer cleaning equipment to restore proper operation.

Deactivation of the domestic water should consist of either valving off those portions of the system that are recommended to be deactivated or, if there are no valves available in the system for this purpose, disconnecting the affected piping and plugging or capping the branch connection point. The closer the valving or disconnection points are to the tunnels or basement areas, the better. Waste or soil piping connected to deactivated fixtures and unused floor drains should be plugged or capped to prevent the escape of sewer gas. Plugs and caps that are removable in the future are available for this purpose.

FOUNTAINS

OBJECTIVE

In the Main House are two fountains, one in the Great Hall and one in the Solarium. The one in the Great Hall is referred to as the Jasper Fountain because the stone of the face and fountain recess is jasper. There is a third fountain on the exterior second floor patio, or Lanai, of the Annex. The fountain in the paved area at the east side of the castle, referred to as the entry court, is known as the Wishing Well. All of the fountains have been deactivated because of deteriorated plumbing or leakage.

All of the fountains are features of the historic scene. In addition, the interior fountains were sources of cooling and humidity for the interior of the Main House. Reactivation of these fountains is important for the historic ambiance, and the interior ones must be considered with respect to the degree of effect or assistance for providing humidity for the building. (See the Climate Control chapter of this report.) This chapter addresses the problems of fountain plumbing systems, the materials of the fountains themselves, and the treatment requirements to return them to sound operating condition, or treatment alternatives.

DOCUMENTATION

Historic Documents

Letter, M. R. Thompson to A. M. Johnson, February 28, 1928:

We are negotiating for some ornamental stone near Goldfield through the courtesy of Dave Aspland who has a letter from the land owner offering same at five dollars a ton. Mr. MacNeilledge has seen it and we will get a few tons for the fountain trimmings, etc. We have to mine it and haul it ourselves, which will come to an additional ten dollars a ton. [Page 1, paragraph 6.]

Letter, M. R. Thompson to A. M. Johnson, September 8, 1928:

Mr. Brown started in yesterday morning having arrived the night before. He is working on the fountain in the living hall. [Page 1, paragraph 2.]

Letter, M. R. Thompson to A. M. Johnson, September 28, 1928:

Mr. Brown has finished pointing up the jasper wall of the fountain in the living hall and waterproofed the edges by copper flashing against the pilasters. He is setting tile base in the guest house and his work looks first class. [Page 1, paragraph 5.]

Letter, M. R. Thompson to A. M. Johnson, January 1, 1929:

Main fountain is finished in living hall and looks fine. Tile is all set for solarium fountain except the top margin where the copper trough and pipes are located. [Page 1, paragraph 5.]

Letter, M. R. Thompson to A. M. Johnson, January 8, 1929:

The sprays for the fountain in the living hall are now finished and produce a very interesting effect. [Page 1, paragraph 3.]

There are some minor differences in detailing of the Solarium fountain as it was constructed that contrast with at least one of the historic drawings.¹²⁸

The wishing well was tiled by the Gospel Foundation. The Foundation also put into operation the fountains by the pool but then that was stopped because children played in them.¹²⁹

The fountains were one of the subjects discussed in preservation needs and recommendations in a memorandum report in 1977:

1. The major problem and that of first priority at the Castle are the fountains.

a. The Jasper fountain in the Living Room of the Main House leaks and according to a DSC Structural Engineer, is in such a poor condition which, if not halted, could cause it some day to go through the floor; dry rot is rampant. This must not wait for a Historic Structure Report; work on it should start and soon. Water in the fountain cannot be turned off as a temporary solution since the moisture is needed to keep the mortar damp and preserve the foundation. The moisture is also required for humidifying the interior of the house. The work will probably involve removal of part of the stair behind the fountain, some replacement of structural members, re-plumbing of the foundation, and, of course, new waterproofing treatment.

b. The small Lanai fountain on the second floor of the Annex is beyond repair according to an expert from the Tile Institute. The fountain is now dry and has been for some time. We should leave it alone until a Historic Structure Report advances recommendations for it.

c. The Solarium fountain has a leaking problem. The Park said that Pat Calhoun (the tile expert) tested here and found the pan to be tight; they assume there is a problem in the drain. The Park will try a small flexible tube inside the present drain, then test for leaks to solve the problem. This fountain has also had leaking at the back from the supply to the dribbler mechanism in the tile wall of the fountain which has caused some rot in the wall. Stucco was repaired at least once by the Gospel Foundation, yet it appears it may need attention again. This must be carefully tested and we may find that plaster on the porch behind the fountain should be removed so new piping can be installed after the wall is waterproofed.¹³⁰

128. See drawing 143/41029, sheet 16 of 41 for example.

129. From notes by Susan Buchel on a visit to Scotty's Castle by Mary Liddecoat, February 12, 1983.

130. Memorandum from Regional Historical Architect, Western Region, through Acting Chief, Division of Cultural Resource Management, Western Region, and Associate Regional Director, Resource Management and Planning, Western Region, to Regional Director, Western Region, March 30, 1977, H30, XC3823. Preparation of 10-238's was recommended in a memorandum with the report from Associate Regional Director, Resource Management and Planning, Western Region, to Superintendent, Death Valley, April 4, 1977, H30, XA5427, XD24.

Later that year a Historic Structure Report was prepared and submitted for compliance review for emergency preservation work on the Living Hall Jasper Fountain.¹³¹ The Historic Structure Report¹³² proposed the following actions:

1. In the controls, installation of a restrictor was proposed in order to permit only a low rate of water through the dribbler so that only a small amount of water would be permitted to flow over the face of the jasper stone face of the fountain. Excess flow was attributed as the source of leakage through the stonework and causing water to reach its way to stair stringers, studs and other structural elements.
2. The dribbler supply pipe was also suspected of contributing to the leakage. It was recommended that the supply pipe be abandoned and a new one be installed (using a different routing so as to avoid dismantling some of the fountain). An access opening in the wall above the stair was required, recommended to be done as a permanent access with a removable panel.
3. The dribbler trough was recommended to be replaced with a clear plastic tube.
4. The stonework mortar "gooey red mortar (red lead) probably added by the Gospel Foundation" was recommended to be replaced with a polysulfide sealant (Thorospan).
5. The pool drains were to be tested, and if found to leak, to by-pass the overflow drain, or insert a plastic tube through the main drain.
6. Instead of replacing rotted framing behind the fountain it was recommended that four steel supports be installed.
7. The framing supporting the copper pan behind the curved part of the grotto and under the stairs was rotted. Replacement was recommended.
8. Ventilation of the space behind the fountain was recommended with an opening at the base of the stair in the Living Hall, and removing a portion of the bottom of the Dining Room lavatory door to permit air flow through holes in the lavatory wall to the space behind the fountain.
9. Monitoring was then to be done, especially to see if these measures would also eliminate water which had previously been found to have run into the floor of the Living Hall.

131. Compliance review memos: Regional Director, Western Region, to California SHPO, October 28, 1977; SHPO to Regional Director, Western Region, November 21, 1977; Regional Director, Western Region, to SHPO, December 5, 1977.

132. Cox, Robert M., Regional Historical Architect, Historic Structure Report, "Jasper Fountain, Main Hall, Main House, Scotty's Castle, Death Valley", Western Regional Office, October 7, 1977.

JASPER FOUNTAIN, GREAT HALL

Findings and Analysis

Description of System. The original system had four manual control valves behind an access panel in the stairway wall behind the fountain. One valve controlled the "dribbler" pipe supplying water to flow down the water wall above the main fountain recess and pool; a second valve controlled the central spray in the middle of the fountain pool; a third valve controlled flow to a pressurized water distribution box and from there was supplied to numerous sprays located in the face of the fountain recess; a fourth valve controlled flow to three equally spaced capped stubouts in the face of the fountain recess. The control valves in the stairway wall have been deactivated and replaced with new valves, accessible through a hinged triangular grille at the base of the stairs.

The fountain operated on a "once-through" principle; water from the domestic water system entered the fountain through the various means described above and then exited through an overflow drain located part way up the back of the fountain pool. Another drain located in the bottom of the fountain pool could be activated by a valve in the basement to completely drain the fountain.¹³³

Conditions

Stonework. Natural fissures in the stone have opened or failed; water seeps through the fissures, and probably deposits chemicals from the water in the fissures. Subsequent wet and dry intervals has put pressure on the stone, somewhat like the effects of freeze-thaw action. As seen in earlier documentation, the mortar deteriorated and several unsuccessful attempts were made to seal the joints (two different sealing materials were apparently used). Thus leakage has occurred both through the stone mortar joints and through cracks in the stone itself. It is predictable that much of the stone will not survive either removal to repair or replace deteriorated substrates nor any attempt to remove the joint sealants, which in itself would be extremely difficult. The stone will crumble, failing at the numerous fissures.

The red joint sealant was probably used to reflect the color of the original joint mortar. The mortar is a dark tone value in photos probably taken by M. Roy Thompson about 1929, as well as in other photos taken during the historic period. Thus the contrast between the stone and mortar appears similar today as it did then.¹³⁴

Deposit of chemicals from water on stonework and tile: This chemical deposit cannot be easily removed. A one-time treatment should not be attempted.

Deterioration of Copper Liner. The half-dome shaped recess of the lower section is backed with horizontal overlapped copper strips, except at the very top part. Leakage through the stonework and of the piping has severely deteriorated part of the copper. If the upper face portion of the

133. See historic drawings: 143/41029, sheet 22 of 49 (July 25, 1929); 143/41031, sheet 80 of 159; and 143/41031B, sheet 30 of 41.

134. Photos, Numbers 18314, 18375, 18641, 19099, ca. 1928-29, S-0108, Scotty's Castle archives.

fountain has a copper barrier it is not visible, although the perimeter was evidently flashed with copper as indicated in the historic correspondence cited above.

Rotting of Wood Framing. Some of the wood frame of the domed recess was replaced in the earlier work. Rotted framing at the sides of the fountain structure was supplemented and supported with added steel members. Some rotted material of the basic framing and backing still remains.

Foundation. The fountain foundation is partly concrete, partly brick. The concrete appears to be in good condition. Brickwork may be adequately solid but needs to be tested and treatment carried out if necessary [see brick chapter].

Plumbing Failures. Piping exhibits various degrees of corrosion and leakage and modifications were made as previously described. The system does not function as originally installed.

Treatment Alternatives

Alternative 1. No Treatment: Not Recommended.

Fountain would have to remain deactivated.

Historic scene/ambiance missing.

Would not have source of humidity in building (if operable, the climate control system would not have to provide as much humidity).

Substrate materials remain a deterioration problem.

Lowest cost in the short term.

Alternative 2. Stabilize/Repair (Partial Treatment): Not Recommended.

May be possible to use sealer (water solvent/carrier) for stone but unknown material composition, effectiveness and effects; may not seal all fissures.

Would not resolve all problems and some deteriorated materials would remain.

Likely to be unsuccessful; could be same or worse result as no treatment.

Greatest cost in the long-run.

Alternative 3. Complete Restoration: Recommended.

Restores historic scene/ambiance.

Restores humidity source for building.

Major, complex project.

High cost but moderate in long-term.

Priority low but increased to achieve added benefit of building humidity source and historic ambiance.

Treatment Design and Specifications Criteria

Determine the feasibility of using a combination of stone sealer and liner replacement so that the stonework would not have to be replaced. The sealer treatment concept is to seal the stone fissures and joint cracks with a clear chemical using water as the initial solvent and carrier. When the chemical has cured it would no longer be water soluble. The other part of this

alternative would be to replace liners and moisture barriers (and provide additional waterproof linings, using copper at visible portions).

If these options are not feasible, stonework replacement would be required. (This also would require locating a source for matching stone and careful and highly detailed recording so the appearance can be duplicated). Use water resistant grout in stonework (determine original grout color and duplicate). Use sealer on replacement stonework.

Either approach will also require the following:

1. Replace plumbing (use plastic in hidden and inaccessible locations).
2. Replace liners, moisture barriers (provide additional waterproof linings; use copper at visible portion).
3. Replace deteriorated structural/framing elements and substrates.
4. Stabilize/repair brick and concrete foundation elements as required during or before the process.
5. Add flow regulators and controls.
6. Provide treated water if recirculating system is used in lieu of a "once-through" system.
7. Treated water and a recirculating system is recommended to prevent mineral staining of the stonework and mineral deposits in the plumbing.

SOLARIUM FOUNTAIN

Findings and Analysis

Description of System. The system has control valves located in the basement below the fountain and behind an access door located behind the fountain on the south wall of the porch immediately north of the Solarium. Water was introduced into a soldered copper "dribbler" trough and from there overflowed through small weirs down the wall of the fountain inside the Solarium. This trough has been replaced (and damaged by the modification) by a copper tube with holes drilled in it at regular intervals. There is another control valve behind the access door that is connected to piping that runs up inside the wall and is exposed on the exterior of the Solarium for a foot or so before it disappears below the roofing tiles. This may have supplied some sort of decorative or cooling spray located in the clay finial in the center of the Solarium roof.

The fountain operated on a "once-through" principle; water from the domestic water system entered the fountain and flowed down the fountain wall, then exited through an overflow drain located part way up the back of the fountain pool. Another drain located in the bottom of the fountain pool could be activated by a valve in the basement to completely drain the fountain.

Conditions

The tilework is reasonably sound, although that on the wall may be less sound than that of the basin. Chemicals in the water have left a chemical film on the tile. The tile grout is fissured, allowing water penetration into the substrates and wall. Plaster is deteriorated and wall framing is rotted. Dribbler and drain plumbing failures resulted in modification of the dribbler. The dribbler trough was deactivated and replaced with a perforated copper tube. This modification caused damage to the historic dribbler trough.

Treatment Alternatives

Alternative 1. No Treatment: Not Recommended.

Fountain would have to remain deactivated.

Historic scene/ambiance missing.

Would not have source of humidity in building (if operable, the climate control system would not have to provide as much humidity).

Substrate materials remain a deterioration problem.

Lowest cost in the short term.

Alternative 2. Stabilize/Repair (Partial Treatment): Not Recommended.

Would not resolve all problems and some deteriorated materials would remain.

Likely to be unsuccessful; could be same or worse result as no treatment.

Greatest cost in the long-run.

Alternative 3. Complete Restoration: Recommended.

Restores historic scene/ambiance.

Restores humidity source for building.

"Small" but complex project, affects other materials.

High cost but moderate in long-term.

Priority low but increased to achieve added benefit of building humidity source and historic ambiance.

Treatment Design and Specifications Criteria

1. Restore wall tilework, retaining existing tile, replace grout.
2. Restore basin tilework only as required.
3. Use water resistant grout, duplicate original grout color and tooling.
4. Replace plumbing (use plastic in hidden and inaccessible locations).
5. Replace liners, moisture barriers (provide additional waterproof linings).
6. Replace deteriorated structural/framing elements and substrates.

7. Replace damaged plaster.

8. Add flow regulators and controls.

9. Provide treated water if recirculating system is used in lieu of a "once-through" system. Treated water and a recirculating system is recommended to prevent chemical deposits on tile and in plumbing.

LANAI FOUNTAIN

Findings and Analysis

Description of System. The system was controlled by a supply valve in the northwest corner of the Lanai, located in a wall recess in the west wall. Water was introduced into the fountain through four evenly spaced ceramic tile "frog" sprays.

The fountain operated on a "once-through" principle; water from the domestic water system entered the fountain through the "frog" sprays, then exited through an overflow drain located in the center of the fountain pool. Historic photographs show that there was a ceramic tile sculpture, a cherub, in the center of the fountain pool. The overflow drain must have been located in this sculpture, although presently the sculpture is missing and all that remains is a rusted-off drain pipe in the center of the fountain pool. Another drain located in the bottom of the fountain pool could be activated by unscrewing a plug to completely drain the fountain.

The water supply and drain piping were probably laid on the original concrete slab and embedded in a concrete overlay for tile paving. The fountain base and plumbing are also assumed to have been added on top of original slab.

Conditions

The bottom tiles of the basin are approximately 8" x 8"; one is missing, four are cracked. The tile is loose, its setting bed to tile bond lost.¹³⁵ The thin grout joints are deteriorated. Curb tiles have numerous glaze failures and joint grout is missing and deteriorated. The four tile frogs also have glaze failures and some broken elements. Caulking has been used to seal cracks. The central ceramic feature is not in place, having been so deteriorated that it was removed and placed in the artifact collection.¹³⁶ All of the tile is mineral stained, both from minerals in the water supply and from the lanai screens. The tile cannot be restored; it will have to be replaced with reproduction tile. Plumbing is rusted, corroded and broken. Fountain leakage has caused stucco failure on the ceiling of the alcove below and is also attributed to wall construction and stucco failures of the first floor section of the Annex (see report chapters on stucco and tile).

135. Imprint in setting bed from back of tile indicates the tile is Spanish: _ _ _ _ M _ N _ A _ _ _ E S E V I L L A.

136. This ceramic cherub is shown in some historic photos, for example see archive photo number 18383, ca. 1928.

Treatment Alternatives

Alternative 1. No Treatment: Not Recommended.

Fountain would have to remain inoperable.

Deterioration will continue. Ultimately full treatment would be necessary because leakage of rain water and snow melt affects stucco and structural elements.

Low cost alternative in short run, most expensive in long run.

Alternative 2. Restore Tilework Only: Not Recommended.

Would stop leakage and deterioration of materials and structure below.

Fountain would have to remain inoperable.

Expensive in long run as the work would have to be re-done if fountain were to be made operable.

Alternative 3. Complete Restoration: Recommended.

Must be accomplished at same time as deck work.

Replace tilework.

Replace plumbing.

Low priority but priority is upgraded because of more important need to eliminate water leakage into structure which is detrimental to other materials and systems.

Treatment Design and Specifications Criteria

1. Fountain and deck restoration should be done at same time.
2. Replace normally inaccessible plumbing with plastic pipe.
3. Duplicate and replace tilework. (Place original tile in artifact collection).
4. Match grout color and tooling and joint sizes to original. Use dense grout -- as water resistant as possible. Do not use caulking gun type joint sealants. For maintaining tile and grout resistance to water absorption, do use a clear liquid tile/grout sealer.
5. Add flow regulators and controls.
6. Provide treated water if recirculating system is used in lieu of a "once-through" system. Treated water and a recirculating system is recommended to prevent mineral deposits on tile and in plumbing.

ENTRY COURT FOUNTAIN (WISHING WELL)

Findings and Analysis

Description of System. According to the historic drawings,¹³⁷ this fountain would have operated in a fashion similar to the other fountains described above. Water would have been supplied into the side pools through several bronze "snail" jets, and into the center "wishing well" from an overflowing hanging bucket suspended in the center of the fountain, filled by a hose fashioned to look like a rope. The water would then have exited through an overflow drain located in side of the central pool.

Openings were provided between the side pools and the central pool at the floor of the fountain to allow water to transfer from the side pools to the central pool to the overflow drain. Another drain located in the middle of the central pool can be activated by a valve in the tunnel below to completely drain the fountain.

Presently, the system is controlled by a valve in the tunnel below the fountain, connected to copper tubing that has been routed through the drain pipe that serves the central drain. The copper tube penetrates the drain pipe wall with the penetration sealed watertight. The copper tubing tees at the floor of the central pool is routed through the transfer openings, and terminates in the side pools. The original overflow piping does not function; overflow is handled by the original "snail" jet piping near the top of the side pools. Garden hoses are connected to the jet piping at the roof of the tunnel below. These hoses drain into piping connected to the main drainage system.

The historically unfinished appearance of the Wishing Well is well illustrated in a 1931 photograph, which shows not only the concrete basins but the graveled entry area.¹³⁸ The fountain was tiled by the Gospel Foundation in the 1950s.

Conditions

The fountain basins leak, probably through the interfaces between the tile and concrete as well as between mortar and tile. Water also probably penetrates the concrete of the central basin. The plumbing is deteriorated and much of the original system has been by-passed. The central metal element needs cleaning and protective coating.

Treatment Alternatives

Alternative 1. No Treatment: Not Recommended.

- Fountain cannot be used without detrimental effects.
- Continued deterioration.
- Low short term cost.

137. See drawings 143/41031A, sheets 3 (Feb. 10, 1931) and 12 of 48, and 143/41033A, sheet 1 (June 6, 1931) of 6.

138. Photo Number 15551, 1931, Scotty's Castle archives.

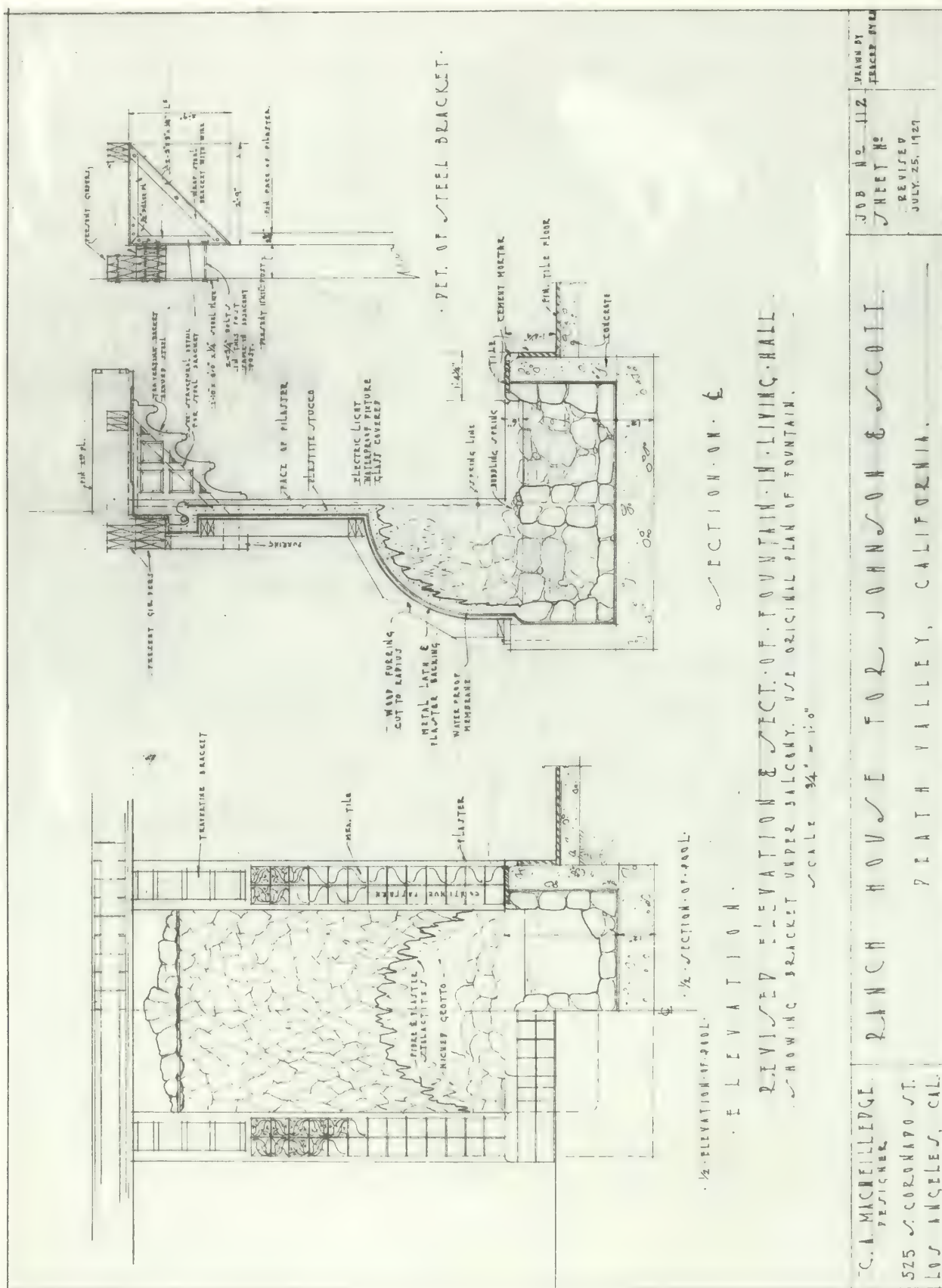
Alternative 2. Restore: Recommended.

Must dismantle extensively to replace plumbing and stop leakage.
Low priority.

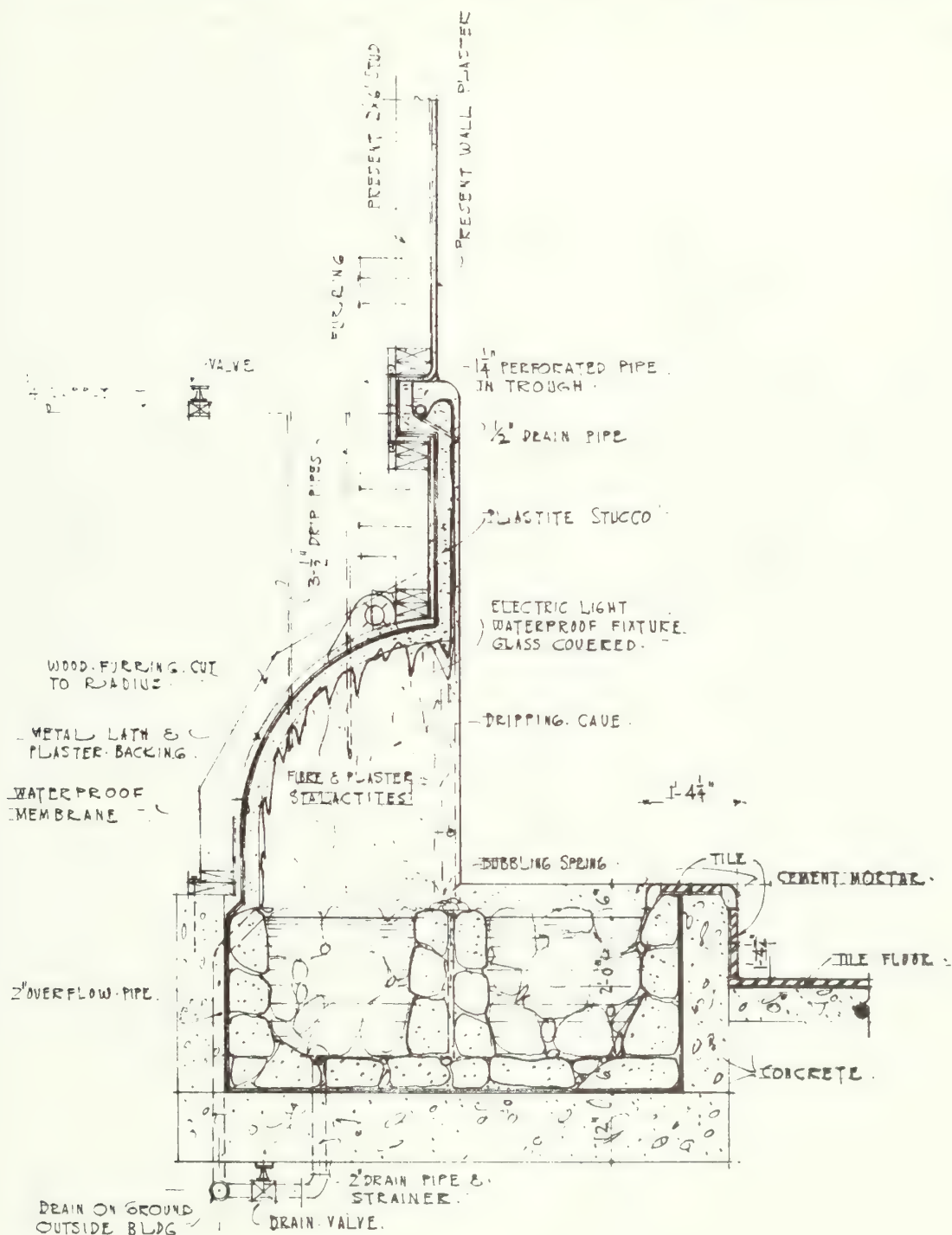
Treatment Design and Specifications Criteria

This fountain was not completed during the original construction but by the Gospel Foundation, and was not tiled according to the original design. The work was done however during the historic period so it will be in accordance with the restoration and maintenance policy to retain the tilework design in its present form. (GMP/FEIS Record of Decision, April 18, 1989; also see building uses chapter of this report.)

1. Replace all plumbing. Use plastic piping in normally inaccessible locations.
2. Provide moisture barriers; add moisture barrier/block in center (round) well.
3. Repair tilework and grout as necessary; replace tiles where required; replace tile grouting.
4. Clean and restore metal element, provide protective coating.
5. Add flow regulators and controls.
6. Provide treated water if recirculating system is used in lieu of a "once-through" system. Treated water and a recirculating system is recommended to prevent mineral deposits on the fountain surfaces and in the plumbing.



Historic Drawing 1: Great Hall Fountain



SECTION OF F.
SHOWING DIAGRAM OF PIPING. 3/4" SCALE.

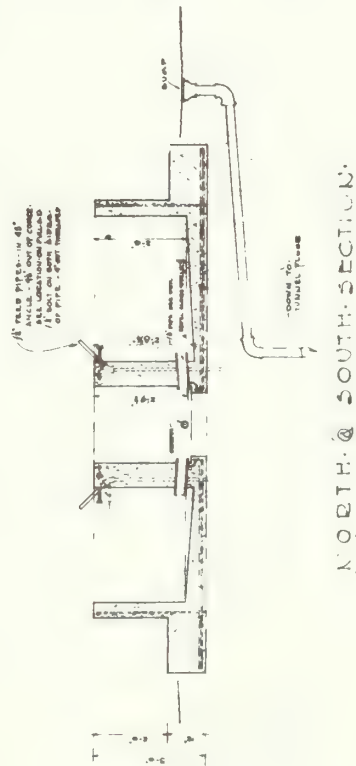
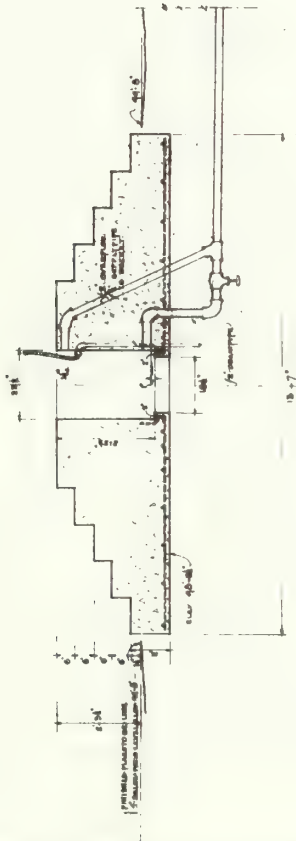
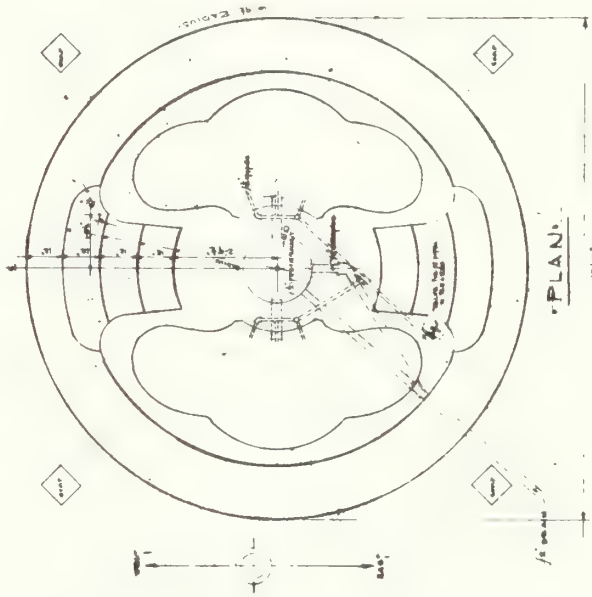
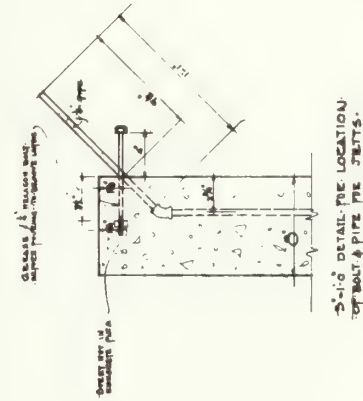
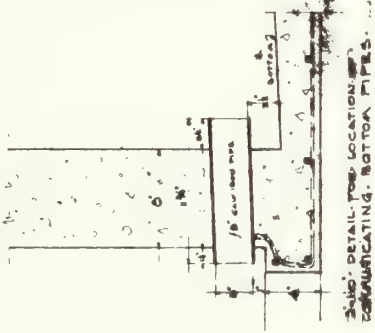
FOUNTAIN IN LIVING HALL DEATH VALLEY RANCH.

A.M. JOHNSON ESQ. G.A. MACNEILL ESQ. DES.

143/41031

Historic Drawing 2: Great Hall Fountain, Section





NOTE: SEE DIMENS. ONE FOR PLAN IN FULL SIZE DETAIL SHEET P-270. FINISH FOUNTAIN ON 1000.

FOUNTAIN IN COURTYARD.
ROUGH CONCRETE CONSTRUCTION.
DEATH VALLEY RANCH, JOHNSON, SCOTT, CAL.

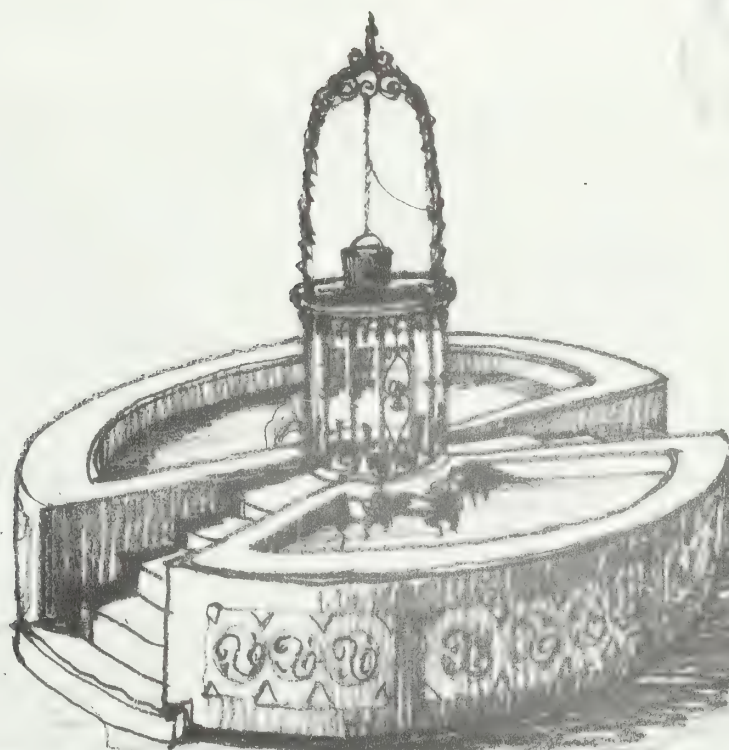
DATE: 8-1930.

SHEET 2014

Historic Drawing 4: Entry Court Fountain

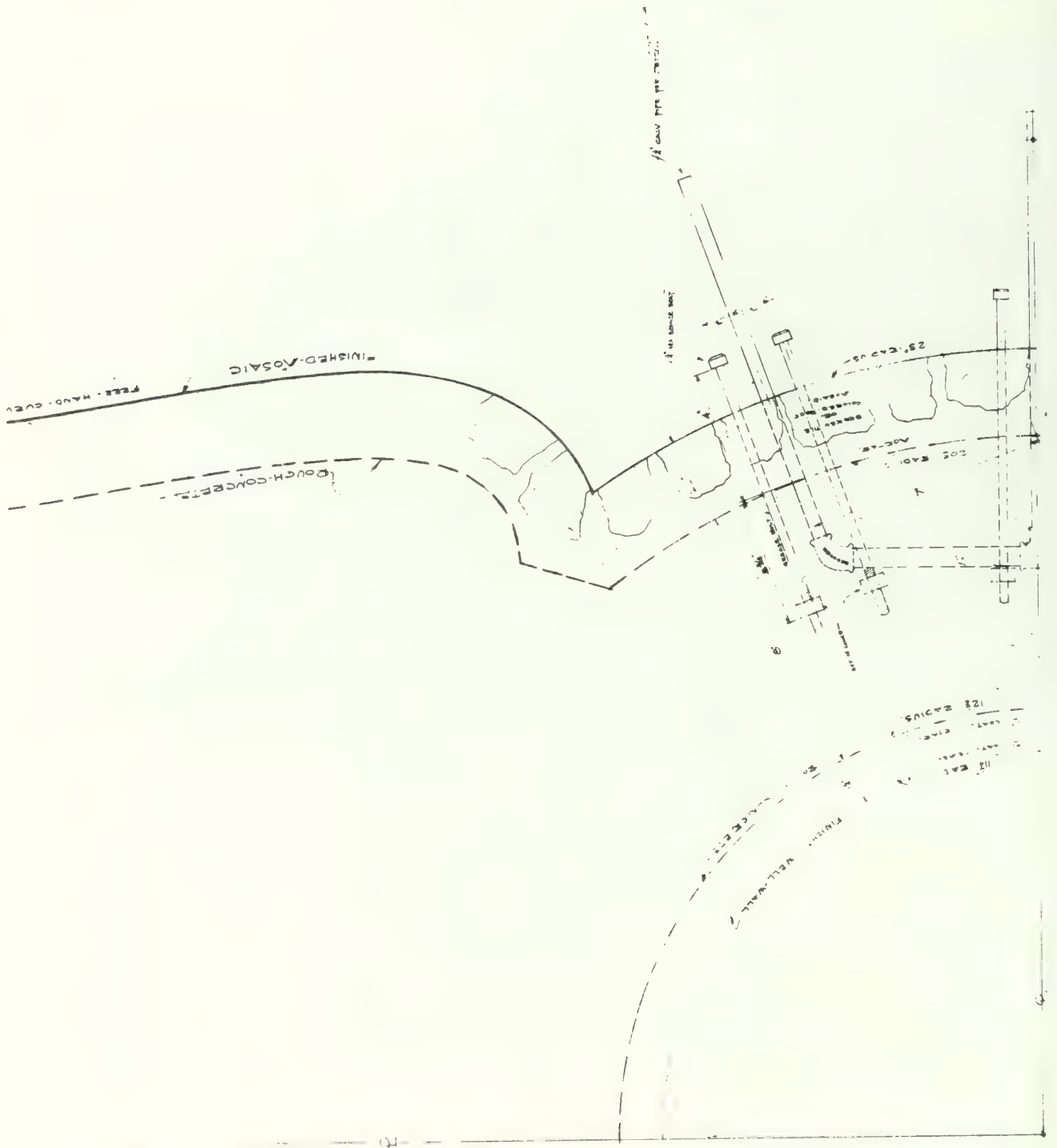


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143-44-200
SHT 58 OF 88

Historic Drawing 6: Sketch of Courtyard Fountain



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143-412314

Historic Drawing 7: Details of Courtyard Fountain

Fountains



Photo 1: Historic Photograph, Living Hall "Jasper" fountain. DEVA S-0108, date unknown. The colored mortar of the stonework is quite dark in black and white photographs.

Photo 2: Living Hall fountain. As it presently appears. A film of minerals from the water has discolored the stonework. Photo by R.L. Carper, June 1990.

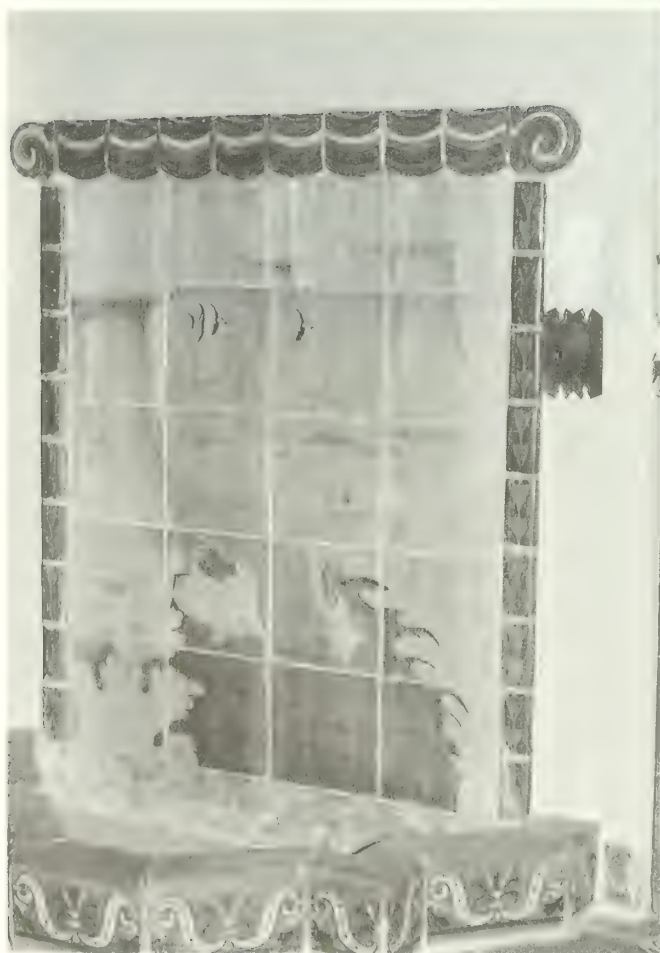


Photo 3: Solarium fountain. Tilework is reasonably sound except for mortar joints, but tile is discolored by minerals in water. Adjacent plaster is damaged from leakage. Photo by R.L. Carper, June 1990.



Photo 4: Historic photograph of Lanai fountain, 1930. DEVA-24182. The fountain can also be seen in photo number 18383, ca. 1928.

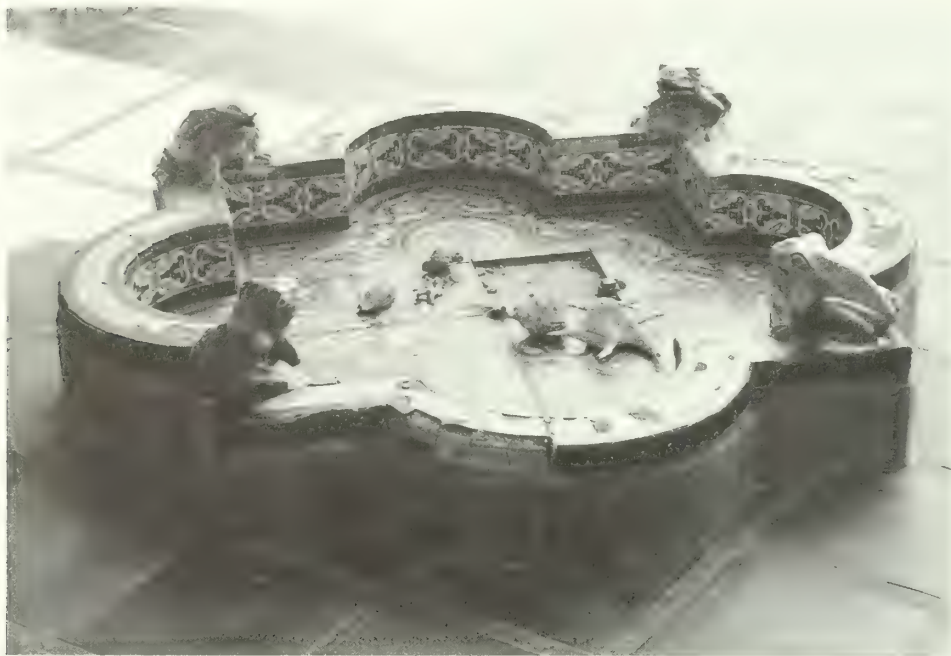


Photo 5: Lanai fountain. Tilework and plumbing is very deteriorated. Center ceramic element is in artifact collection. Photo by R.L. Carper, June 1990.



Photo 6: Lanai fountain. Shutoff valve and deck drain in northwest corner of Lanai. Photo by R.L. Carper, June 1990.

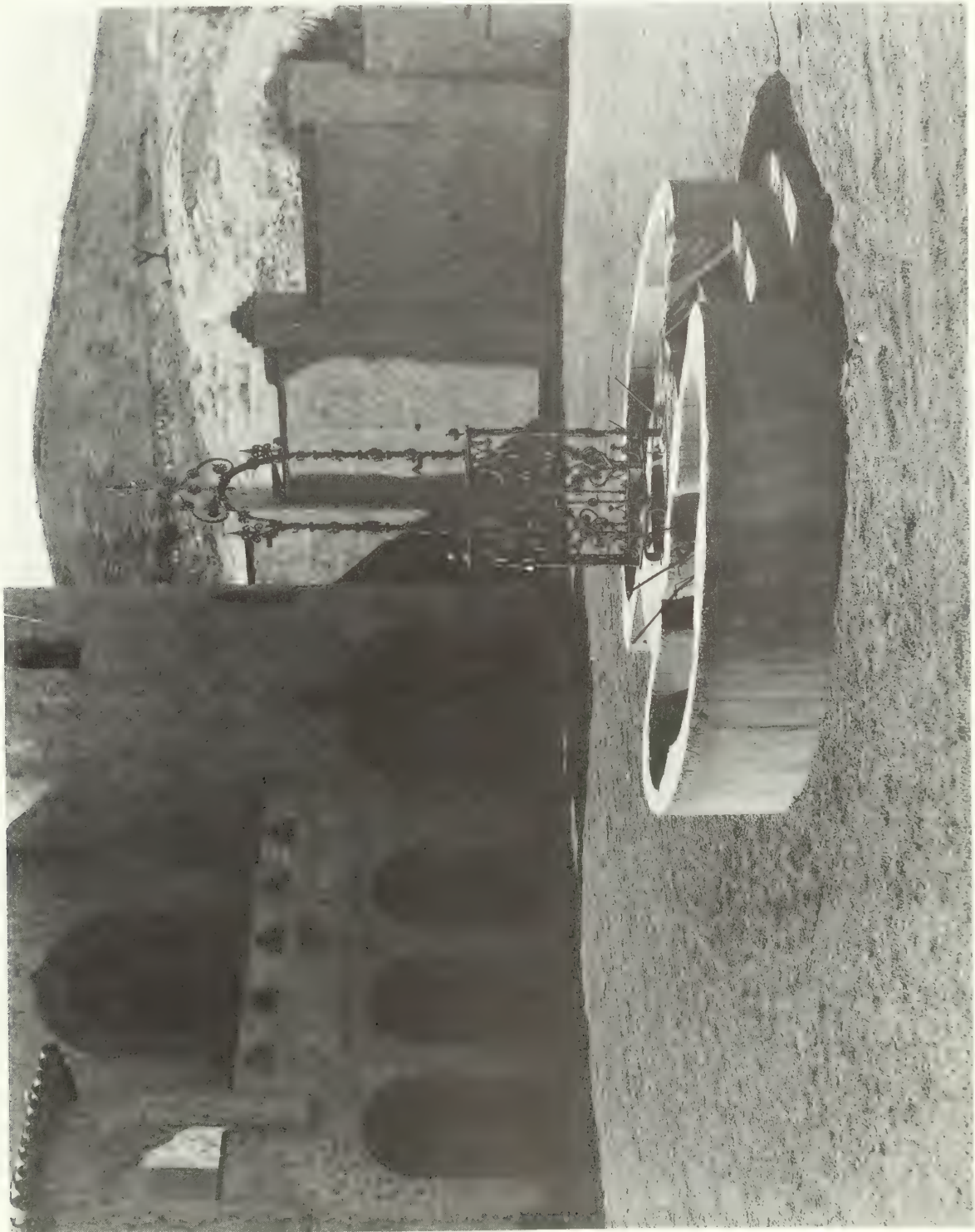


Photo 7: Entry court fountain. Historic photograph by M.R. Thompson, 1931. DEVA-15551.

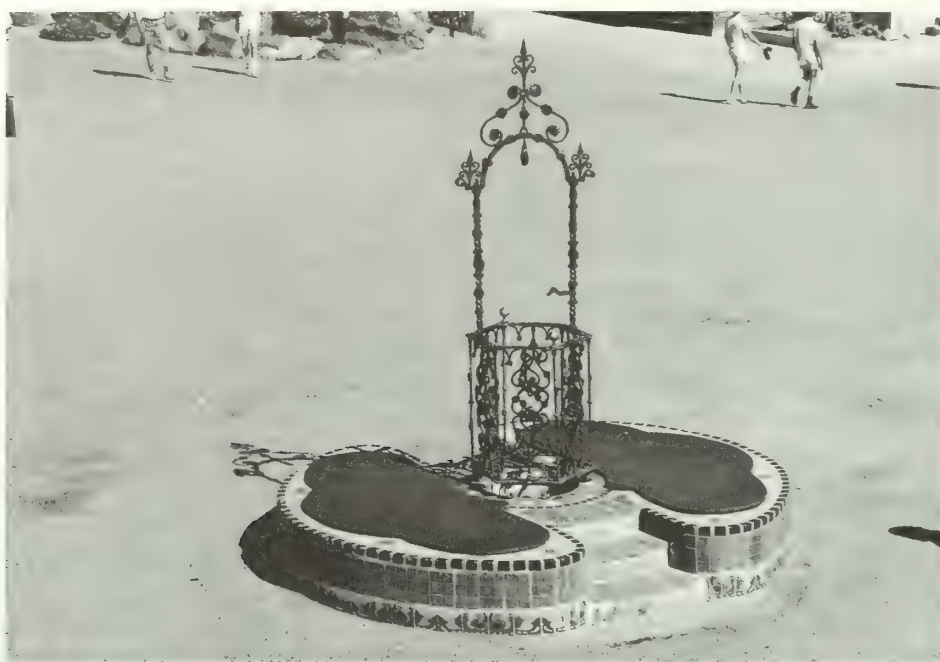


Photo 8: Entry court fountain. Not in service because of leakage and deteriorated plumbing. Photo by R.L. Carper, June 1990.

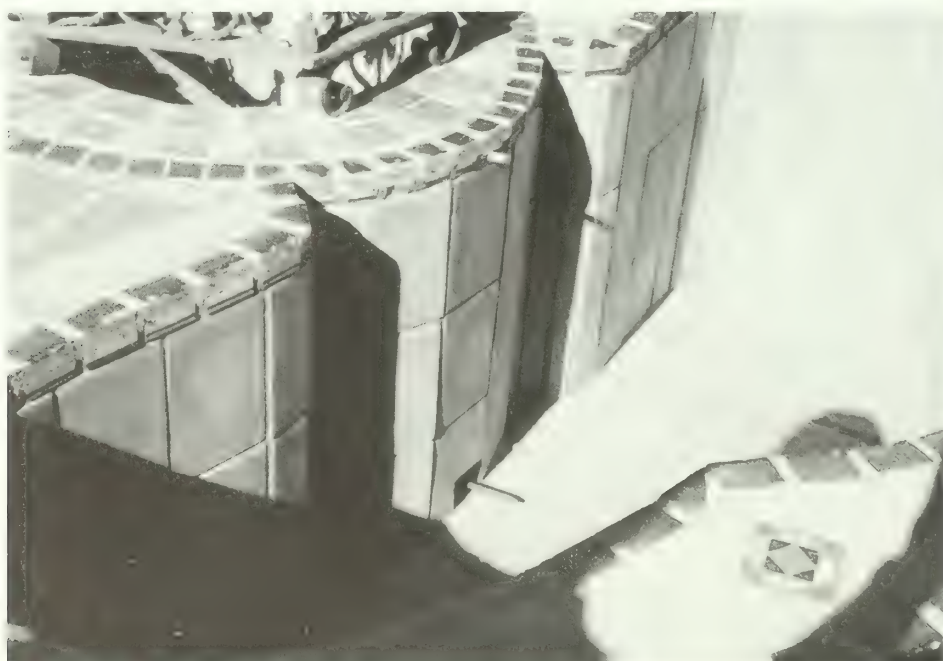


Photo 9: Detail of entry court fountain. Shows supply tube inserted through drain pipe (lower) and spray element supply pipes at top edge of basin now used as drains. Tile design is not as originally intended. Photo by P.C. Cloyd, April 1990.

COURTYARD ARBOR

OBJECTIVE

The courtyard between the Main House and the Annex was covered, until approximately 1950, with a grape arbor, a latticed structure of eucalyptus logs and poles. This chapter is an assessment of the appropriateness of the reconstruction of the arbor as it relates to the historic period, as well as the feasibility of restoring the feature.

DOCUMENTATION

Historic Documents

Sylvan Acres to ...?..., August 3, 1927: "Received payment for Eucalyptus poles." (From research notes in vertical files, [5/1], SC, DEVA).

The following are excerpts from historic correspondence. The letters were copied from the historical document collection at Scotty's Castle and compiled in a notebook ca. 1972, as indicated in an attached note by Susan Buchel, dated November 7, 1984. Presumably the file does not include all the letters. The complete group of documents are in manuscript collections (MSS) 5, 6, 7, 9, 10 and 12. The notebook file is listed in the Scotty's Castle library as No. 979.487N, Acc. #898. Most of the letters in the file are correspondence between Matt Roy Thompson and Albert M. Johnson. The notebook file begins with January 12, 1926 and ends at December 30, 1930.

M. R. Thompson to A. M. Johnson, March 25, 1929:

Carpenters are laying and fastening the poles in place above the patio. [Page 1, paragraph 6.]

M. R. Thompson to A. M. Johnson, May 5, 1929:

We set out six wild-grape vines in the patio flower beds last week, transplanted from the lower field. [Page 1, paragraph 3.]

Historic drawings indicate that the main logs spanning the patio were to be 10 inch diameter eucalyptus, at a maximum spacing of approximately 6 feet 9 inches.¹³⁹ Other drawings show details of the complete construction, probably as proposed: 1 by 3 trellis work on 2 by 8 joists spaced at 2 feet 6 inches on center (10 spaces at 2'-6" = 25'-0" plus 6" to Main House wall and 1'-0" to the Annex wall), supported by the eucalyptus logs.¹⁴⁰ Historic photographs however do not indicate that the arbor was built in that manner. Poles on and perpendicular to the

139. Drawing No. 143/41029, sheet 26 of 41 (No. 18 in group used in draft of structural chapter of this report.)

140. See for example Drawing No. 143/41029B, sheet 7 of 36, Aug. 1, 1926 and revised December 10, 1926.

supporting logs formed a more or less square grid.¹⁴¹ The historic photos also show that the logs and poles developed considerable sag before the arbor was removed.

NPS Period

In 1973 the park received some eucalyptus logs "(22 long plus short lengths)" from Berkeley, California which were intended to be used to reconstruct the arbor. They were donated by the (San Francisco) East Bay Parks. However, they were reported to have been too warped to be usable.¹⁴²

ANALYSIS AND FINDINGS

The following excerpt is from the National Register nomination, dated July 20, 1978 (date of listing):

A tiled courtyard between the two structures [Main House and Annex] was originally covered with eucalyptus logs to provide a sun screen and grape arbor. These have been removed. However, there are plans to replace them in the near future.

Among the proposals of the draft Interpretive Prospectus (February 1989) is (also see building uses chapter of this report):

The courtyard between the Main House and the Annex should be refurnished with custom reproductions, and have its overhead eucalyptus log trellis reinstalled.¹⁴³

The trellis supporting logs spanning the courtyard were set into the Annex wall, whereas the ends at the Main House wall were supported by wooden seats projecting from the wall. These seats were shaped from a rectangular timber, the top shaped with a nearly half-round depression to hold the logs. These seats appear to be in reasonably sound condition. When the trellis was removed, the logs were cut off at the face of the Annex wall, the ends still remaining in the wall.

141. Historic photos show all logs and poles, three layers, but very few in the top layer. Archive photos showing the arbor include Numbers 11332 (18302 similar), 14356, 15561 (1931), 15584 (1929), 16942, 16943, 16948, 18333, 18483, 18485, 18488, 18510, 18650, 18652, 18779 (ca. 1950), 18839, 19331, 20221, 20243 (Nov. 1931).

142. Memorandum from Regional Historical Architect, Western Region, through Acting Chief, Division of Cultural Resource Management, Western Region, and Associate Regional Director, Resource Management and Planning, Western Region, to Regional Director, Western Region, March 30, 1977, H30, XC3823. Preparation of 10-238's was recommended in a memorandum with the report from Associate Regional Director, Resource Management and Planning, Western Region, to Superintendent, Death Valley, April 4, 1977, H30, XA5427, XD24.

143. Interpretive Prospectus (Draft), Death Valley National Monument, February 1989, pg. 21.

ALTERNATIVE TREATMENTS

Alternative 1: Reconstruct All of Arbor

This would re-establish the historic scene in its entirety. It would also be the highest cost alternative.

Depending on the extent of vine growth, a benefit would be the provision of additional shading of the patio, which would help to reduce the temperature in portions of the two buildings. For the visitors, the Annex Alcove would also be cooler, which is the first meeting point of the tours.

The extent of vine growth would be determined to some degree from historic photographs. Some earlier photos do not show very extensive growth. Structural considerations may also limit the degree of growth permissible.

Alternative 2: Reconstruct a Portion of the Arbor

This option would recreate only a portion of the historic scene, the concept to provide a section east of the bridge to provide shade for the Annex Alcove and the visual effect. The overall cooling effect would be proportionally less, but so would the cost.

Alternative 3: No Action, That Is, Do Not Reconstruct Arbor

The obvious benefit of this option would be no cost, except air conditioning costs (ultimately) could be slightly higher than if either the full arbor or a portion of it were reconstructed, deriving some shading. Any cost benefit of less load on the proposed climate control system could well be offset in increased costs of maintenance of the arbor.

RECOMMENDATIONS

Reconstruction of the arbor would be consistent with the interpretation and restoration policy and thus supportable. However, it is suggested that it be regarded as a low priority, except as it may relate to one of the methods of improving building climate control to reduce temperatures within the buildings.



Photo 1: Arbor, historic photograph, ca. 1930s. DEVA-24212. Taken from roof of Main House.

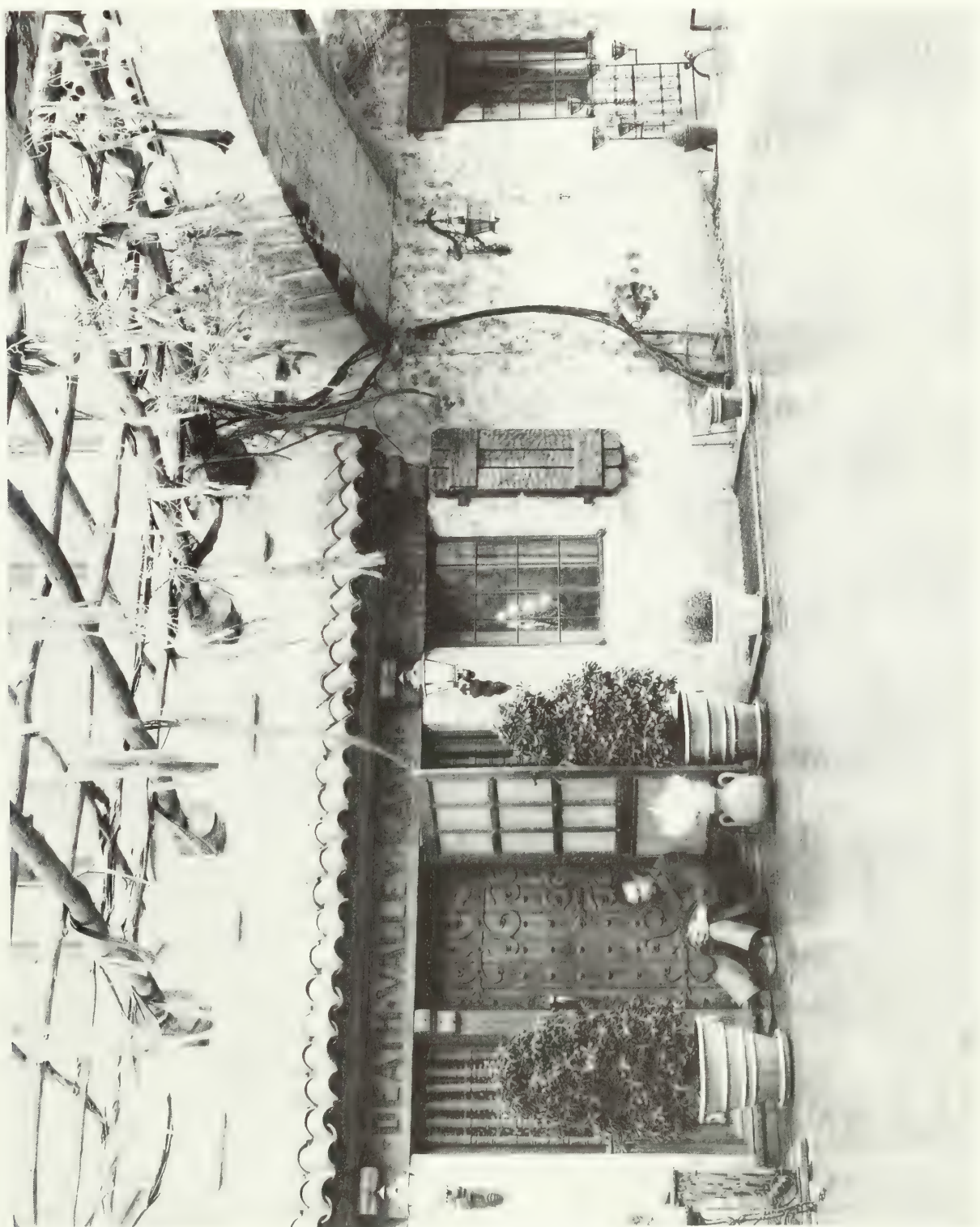


Photo 2: Arbor, view in patio, historic photograph, ca. 1930s. DEVA-24214. View in patio at north entrance to Main House showing arbor.



Photo 3: Patio and arbor, historic Craig photograph, 1938, S-0482, DEVA-18760.

ELECTRICAL SYSTEM ASSESSMENT

OBJECTIVES

The purpose of this chapter is to examine the existing electrical system to determine load capabilities for future installation of climate control system equipment, and to assess present and future site electrical needs. The existing system is discussed, along with possible solutions for system expansion.

SUMMARY/RECOMMENDATIONS

It is recommended that, at present, a new overhead open delta bank of transformers on the existing overhead line be provided for the new climate control loads. New metering and distribution equipment would be provided to feed the new loads. The existing overhead transformers and switch gear would remain to feed existing loads.

The primary electrical system will be re-evaluated during installation of the new climate control system to determine if additional upgrading or modification is needed.

It is also recommended that a new standby power system be provided for the facility. At this time, the critical loads, and therefore the standby system capacity, has not been determined.

DOCUMENTATION

Existing Electrical Distribution System

Commercial power is provided by Southern California Edison via an overhead line which operates at 14,400 volts, single phase, 60 hertz. 480-volt, three-phase service for the ranch is derived from two 75-kva, pole-mounted, oil-filled distribution-type transformers. The transformers are connected in an open wye-open delta configuration with a system capacity of 129 kva.

The transformer pole is located approximately 130 feet east of the fire cache. There are two 480-volt underground services from the transformers, one for the National Park Service and one for the concessioner, TW Services.

Service for the National Park Service is underground from the transformer pole to a 480-volt, 3-phase, 3-wire, 400-ampere switchboard located at the east side of the fire cache. The 400-ampere switch is fused at 225 amperes. Metering for the utility company, Southern California Edison, is also located in the switchboard. Three #4/0 conductors in 2-inch conduit are run from the switchboard to the power house via the utility tunnel system. Service for the various buildings is tapped from the 3#4/0 conductors and transformed to 208Y/120-volt, 3-phase, 4-wire for utilization.

A 480-volt, 3-phase, 75-kw standby diesel generator set is located in the power house to supply standby power for the system. However, the generator set is inoperative at this time. An historic pelton wheel generator set rated 7-kw, 125-volts DC located in the power house supplies power for outdoor lighting.

Service for TW Services is underground from the transformer pole to a 480-volt, 3-phase, 4-wire meter cabinet located on the south side of the bunk house. The meter cabinet contains metering for the utility company and a 200-ampere service entrance circuit breaker. Service is utilized at 480Y-volts and 208Y/120-volts for the gift shop, snack bar and employee housing.

System Loading

Copies of electric power bills for December 1988 through December, 1990, for the National Park Service and the concessioner were used for this report. KWH and maximum demand are shown in figures 1 and 2 for the Park Service and the concessioner respectively. Figure 3 shows the combined loads for the Park Service and the concessioner. Although it is unlikely that maximum demand for the Park Service and concessioner would occur at the same time, it will be assumed that this does occur as a worst case.

The highest demand for the system occurs during the heating season, January and February with a maximum KW demand of 116 kw. Maximum demand of 94 kw for the summer cooling season occurs July through August.

SYSTEM CAPACITY

As stated previously, the full load capacity of the existing 480-volt, 3-phase, 3-wire electrical system is 129 kva, which is the full load capacity of the open delta transformer bank. Assuming a system power factor of .85, full load capacity is 110 kw. Maximum demand recorded for the heating season was 116 kw and occurred from January 19 to February 16, 1989. Maximum demand recorded for the cooling season was 93.4 kw and occurred from July 13 to August 14, 1990.

The transformers are overloaded approximately 5.5 percent during the heating season based on a .85 power factor, but this is not a problem. 1988 hygrothermograph data for Scotty's Castle indicates a maximum average temperature of 61°F (16°C) for the period January 19 to February 16, 1989 in which the 116-kw demand was recorded. Based on this data, the transformers could be overloaded approximately 14 percent with no loss of life expectancy.

During the cooling season, the transformers would have to be derated because of the high ambient summer temperatures. Based on the same hygrothermograph data, the average maximum temperature was 100°F (38°C) for the period of July 13 through August 14, 1990 in which the 93.4-kw demand was recorded. Based on this data, the transformers would have to be derated 12 percent or 13 kw. System capacity would be 97 kw.

This transformer loading data is a worst case scenario since it is highly unlikely that the maximum demand for the heating and cooling seasons occurred on the day with the maximum average temperatures. However, it is apparent that the transformers are close to being fully loaded and additional loads would require upgrading the system.

System capacity for the concessioner's secondary electrical distribution system is adequate for current and future loads. Load data indicates that the maximum demand from December 16, 1988 to September 13, 1990 was 51.8 kw. System capacity, based on the 175A service disconnect circuit breaker is 145 kva. For worst case, the system is loaded to approximately 45 percent of capacity.

System capacity for the National Park Service secondary electrical distribution system is also adequate for current and some future loads. Load data indicates that the maximum demand from December 16, 1988 to September 13, 1990 was 75 kw. System capacity based on the 225A service fuses is 186 kva. However, in order to meet the National Electrical Code Recommendations of three percent voltage drop on the existing #4/0 feeder, system capacity would be limited to 158 kva. For worst case, the system is loaded to approximately 56 percent of capacity.

In summary, although some system capacity for future loads exists on both the NPS and concessioner's secondary distribution systems, additional loading cannot occur until transformer capacity is increased.

ELECTRICAL SYSTEM UPGRADE

Recommendations for the electrical system upgrade are based on installing the mechanical system recommended in the climate control assessment. This system, package water source heat pumps with electric (electrode boiler type) humidifiers and with improvements to the building envelope will increase electrical loads by approximately 85-kw maximum in the winter and approximately 70-kw maximum in the summer.

As previously stated, the electrical system is fully loaded, and additional loads cannot be added unless transformer capacity is increased.

Normally, with an open delta system, a third transformer can be added to the existing bank to increase system capacity. This cannot be done in this situation because the primary service is single phase instead of three phase.

There are three possible solutions for providing increased transformer capacity for the new climate control system loads for the facility.

The first solution would be to provide a new open delta bank of transformers on the existing overhead system, and new service for the new loads. The power company, Southern California Edison, could provide the additional transformer bank for a small initial cost, \$300.00 to \$500.00.

The second solution would be to replace the existing overhead service with a new underground service for existing loads and provide a new underground service for the new loads. Open delta pad mounted transformers would be used for the underground service. The existing overhead single phase primary would not be changed. The SCE cost would be approximately \$4,500.

The third solution would be to upgrade the existing overhead system to a three phase line from the California-Nevada border to Scotty's Castle. This work would be accomplished by SCE. A new three phase pad mounted transformer would be provided to feed existing and new loads for the facility. The SCE cost would be approximately \$40,000.

Solution number one, provide an additional open delta transformer bank, is the least expensive solution. However, discussions with park personnel indicate that the overhead systems are not in accordance with the requirements for the historic restoration program for the facility. The overhead line also represents a safety and fire hazard.

Solution number two, provide open delta underground service would be more expensive than the overhead system, but would better meet the requirements for the historic restoration program because the underground system would be historically correct. The existing switchgear cabinet adjacent to the fire cache could also be removed.

The biggest problem with solutions one and two is the fact that the open delta configuration in which three phase secondary voltage is obtained from a single-phase primary, is best suited to electrical systems with large single phase and small three-phase loads. The configuration is not used with large three-phase loads, because even with balanced three-phase loads, the load voltages can become unbalanced to an extent depending on the independence of the transformer and the load power factor. Voltage measurements taken on the concessioner's system, which has a large three phase air conditioner, did show a voltage imbalance, (A-B:503V., B-C:465V., C-A:480V.). Although this voltage imbalance does not appear excessive, an open delta configuration with 85 kw of three phase loads for the castle climate control system, could result in excessive voltage imbalance, which could cause overheating and shortened life expectancy of equipment.

It would appear that with the possible voltage imbalance problems, the incoming primary overhead line should be upgraded to three phase. However, at the present time, the recommended solution is number one--provide a new open delta bank of transformers on the existing overhead system, and new service for the new loads. Upgrading the overhead line to three phase would remain an option.

The high costs for upgrading the overhead system to three phase is based on the fact that initially, because of the phased climate control system installation, there will be very little load on the new system. SCE construction costs are based on the amount of revenue received from the new service. The \$40,000 cost for upgrading the line reflects the small loads, approximately 5 kw, which will initially be connected to the new service. If the entire climate control load of 85 kw was being connected to the new service, SCE construction cost could be as low as \$20,000.

Based on the high cost for construction of the three phase line, an additional overhead open delta system is the best solution, at least for the present. Voltage imbalance can be monitored. If it becomes a problem, upgrading the single phase line to three phase can be implemented.

Pad mounted open delta transformers could be provided after the climate control project is completed if there are no voltage imbalance problems and if the park feels this would better meet the requirements for the historic restoration project.

The recommended location for the transformers is on an SCE pole located south of the road opposite the utility tunnel under the swimming pool. Secondary service would be provided from the pole to new metering at the south end of the tunnel. This secondary service would run overhead from the transformer pole to an existing pole located just north of the road, then underground from that pole to the meter.

RANCH SECONDARY ELECTRICAL SYSTEM

It is recommended that the existing secondary electrical system for the ranch be retained. New branch circuit wiring was installed in the castle in the mid-1980s by NPS staff and is in good condition. Panelboards, safety switches, transformers, and feeders also appear to be in good condition. Implementation of a good maintenance program would insure future reliable

operation of the system, and is strongly recommended. This would include annual visual inspection, checking tightness of connections, and testing circuit breakers and the grounding system.

New distribution equipment will be required for distribution to the climate control equipment.

EMERGENCY SYSTEMS

The existing 75-kw engine generator in the power house is currently not functional. It could be returned to service but it is reported that parts are not available. Based on load data, the generator is large enough to accommodate the existing NPS loads for the ranch. Additional loads would require a larger generator.

The existing generator could provide emergency power for approximately one-third of the new heat pumps, provided only the heat pumps are on the generator. Capacity would be limited by the starting KW of the generator. In order to limit starting kw, each heat pump would have to be started individually with at least a ten-second time delay between each unit start.

Re-use of the existing generator is, at best, an interim solution. The unit is old and will require frequent repair and maintenance. Additional load capacity is needed for existing and future loads.

Critical load requirements for sizing the generator would have to be determined by the park. A 75-kw unit would be suitable if only one-third of the heat pumps were needed. Small critical non-motor loads, like the fire alarm and intrusion system, could also be included.

If all building loads were critical, a considerably larger unit would be needed. Based on required starting kw capacity for the motor loads and existing and future non-motor loads, a 300-kw generator may be required.

The best location for a new generator would be in the power house in the same location as the existing unit. However, preliminary evaluation indicates that it should be assumed that this generator should be retained in place and treated as part of the historic period rather than being removed and replaced with a new generator. Location options were considered. To date the recommended location option is at the outside end of the tunnel under the swimming pool. The unit would operate on No. 2 diesel fuel and have a water-cooled exhaust manifold for city water cooling.

ELECTRICAL LOAD DATA
Meter No. P729-005149
NATIONAL PARK SERVICE

<u>BILLING PERIOD</u>	<u>KWH</u>	<u>KW DEMAND</u>
12/16/88 - 01/19/89	28800	66.0
01/19/89 - 02/16/89	24480	75.0
02/16/89 - 03/17/89	14400	42.0
03/17/89 - 04/13/89	12800	32.0
04/13/89 - 05/16/89	14880	37.0
05/16/89 - 06/15/89	13120	37.0
06/15/89 - 07/18/89	16000	38.0
07/18/89 - 08/15/89	15360	38.4
08/15/89 - 09/14/89	13760	38.4
09/14/89 - 10/13/89	12000	32.0
10/13/89 - 11/14/89	13280	41.6
11/14/89 - 12/14/89	16640	54.4
12/14/89 - 01/16/90	23200	59.2
01/16/90 - 02/14/90	22080	64.0
02/14/90 - 03/15/90	17920	64.0
03/15/90 - 04/13/90	12160	44.8
04/13/90 - 05/15/90	11680	32.0
05/15/90 - 06/14/90	11680	35.2
06/14/90 - 07/13/90	13920	36.8
07/13/90 - 08/14/90	17440	41.6
08/14/90 - 09/13/90	16640	40.0

Figure 1: Electrical Load Data, Meter No. P729-005149, National Park Service

ELECTRICAL LOAD DATA

Meter No. 835-000110

TWA SERVICES, INC.

<u>BILLING PERIOD</u>	<u>KWH</u>	<u>KW DEMAND</u>
12/16/88 - 01/19/89	15144	42.0
01/19/89 - 02/16/89	12024	41.0
02/16/89 - 03/17/89	9768	37.0
03/17/89 - 04/13/89	12264	47.0
04/13/89 - 05/16/89	14544	46.0
05/16/89 - 06/15/89	12216	39.0
06/15/89 - 07/18/89	18888	46.0
07/18/89 - 08/15/89	17952	46.1
08/15/89 - 09/14/89	15864	42.7
09/14/89 - 10/13/89	12312	40.1
10/13/89 - 11/14/89	11256	41.0
11/14/89 - 12/14/89	11280	40.1
12/14/89 - 01/16/90	13080	34.6
01/16/90 - 02/14/90	12432	37.4
02/14/90 - 03/15/90	11712	38.4
03/15/90 - 04/13/90	12792	40.6
04/13/90 - 05/15/90	14760	43.9
05/15/90 - 06/14/90	12360	41.0
06/14/90 - 07/13/90	17664	46.6
07/13/90 - 08/14/90	21024	51.8
08/14/90 - 09/13/90	14280	44.4

Figure 2: Electrical Load Data, Meter No. 835-000110, TWA Services, Inc.

ELECTRICAL LOAD DATA
TOTAL NPS AND TWA SERVICES, INC.

<u>BILLING PERIOD</u>	<u>KWH</u>	<u>KW DEMAND</u>
12/16/88 - 01/19/89	43,944	108.0
01/19/89 - 02/16/89	36,504	116.0
02/16/89 - 03/17/89	24,168	79.0
03/17/89 - 04/13/89	25,064	79.0
04/13/89 - 05/16/89	29,424	83.0
05/16/89 - 06/15/89	24,336	76.0
06/15/89 - 07/18/89	34,888	84.0
07/18/89 - 08/15/89	33,312	84.5
08/15/89 - 09/14/89	29,624	81.1
09/14/89 - 10/13/89	24,312	72.1
10/13/89 - 11/14/89	24,536	82.6
11/14/89 - 12/14/89	27,920	94.5
12/14/89 - 01/16/90	36,280	93.8
01/16/90 - 02/14/90	34,512	101.4
02/14/90 - 03/15/90	29,632	102.4
03/15/90 - 04/13/90	24,952	85.4
04/13/90 - 05/15/90	26,440	75.9
05/15/90 - 06/14/90	24,040	76.2
06/14/90 - 07/13/90	31,584	83.4
07/13/90 - 08/14/90	38,464	93.4
08/14/90 - 09/13/90	30,920	84.4

Figure 3: Electrical Load Data, Total NPS and TWA Services, Inc.

FIRE DETECTION SYSTEM ASSESSMENT

PURPOSE

The purpose of this assessment is to examine the existing fire detection system to determine adequacy and provide recommendations for system upgrades.

SUMMARY/RECOMMENDATIONS

The existing fire detection system does not provide adequate coverage for the Main House and Annex and should be expanded to cover the utility tunnel, all rooms, and accessible ceiling spaces.

The existing control panel should be replaced with a new panel which meets UL and NFPA requirements.

The system should also be expanded to cover other buildings of the ranch complex.

EXISTING FIRE DETECTION SYSTEM

The existing fire detection system is a ten-zone automatic detection system utilizing smoke detectors. The control panel is a locally manufactured panel which also controls the security system. Alarms report to remote annunciators and, recently, a telephone dialer has been installed.

SYSTEM UPGRADE

The system should be upgraded to provide complete coverage for all rooms in the Main House and Annex. The coverage should also be extended to accessible ceiling plenum and attic spaces and the tunnel.

Additional detectors should be installed in the existing fire zones. In most cases, coverage needs to be expanded because the vaulted or beam ceiling constructions do not allow movement of smoke along the ceilings. A substantial fire could be in progress before the system went into alarm.

System upgrade should also include replacement of the existing control panel. The panel is apparently not UL-listed and does not appear to meet NFPA requirements. The new panel should be expandable to twenty-five zones to include future expansion.

System upgrade has already started. NPS personnel are adding new smoke detectors.

The recent Cookhouse fire demonstrates the need to extend the system to other buildings in the ranch complex.

SECURITY SYSTEM ASSESSMENT

PURPOSE

The purpose of this assessment is to examine the existing security system to determine its adequacy and provide recommendations for system upgrade.

SUMMARY/RECOMMENDATIONS

The existing security system does not provide adequate coverage for the Main House and Annex, or the site, and should be expanded.

The existing control panel should be replaced with a new panel which meets UL requirements.

EXISTING SECURITY SYSTEM

The existing security system consists of three sub-systems, all reporting to the central control panel. The panel is also used for the fire alarm system.

The first sub-system consists of microphones located in the Main House and Annex. This sub-system has four zones.

The second sub-system, containing five zones, consists of TV cameras located in the Main House and Annex. These zones and the microphone sub-system are linked to remote television monitors.

The third sub-system consists of a ten-zone system of passive infrared detectors. Detectors are located throughout the Main House and Annex.

All three sub-systems, along with the fire alarm system, are monitored. The detector sub-system, along with the fire alarm system, will report alarms through the telephone dialer.

SYSTEM UPGRADE

Camera and microphone sub-systems appear to be adequate. The detector system is in fairly good condition, but it appears that some expansion and upgrade are required with the addition of detectors in certain rooms.

It is recommended that consideration also be given to replacing existing passive infrared detectors with new dual microwave/infrared detectors. These detectors can be operated at higher sensitivity levels with fewer false alarms.

It is also recommended that a walk-through test be conducted to ensure adequate coverage on the existing system.

Along with the fire alarm system, system upgrade should include a new UL-listed security panel. The panel should be expandable to twenty zones for the detection system. Similar to the fire alarm system, the system should have remote annunciators. Arming stations should be

provided at appropriate locations. The microphone and TV monitoring system should also have a separate control panel.

TREATMENT RECOMMENDATIONS SUMMARY

STORM DRAINAGE

Lower soil level in Patio planter boxes (see tile chapter).

Regrade and resurface Entry Court for positive surface drainage, remove subsurface drains; provide color treatment for more gravel-like appearance of new paving, which is required for accessibility and dust control.

Adjust elevation of drain pipes in main tunnel roof slab (along swimming pool) to prevent ponding and connect with new piping in tunnel to existing storm drain piping.

Restore grades at foundation wall in front of Main House, adjust grades at porch slabs.

Regrade area west of Castle and north of Annex for positive drainage.

Clean and regrade swale on hillside north of Annex for positive drainage.

Treat concrete slab at rear of Annex (included in structural chapter).

Monitor leakage in Main House basement walls.

PEST MANAGEMENT

Continue and enhance treatment for termites, carpenter bees and mud daubers. Obtain expert consultation on pesticide materials and treatment which will control insects without effects on building materials and meet goals for reduction or elimination of use of toxic chemicals.

Continue installation of storm drainage piping in tunnels to reduce attraction to insects (see drainage chapter).

STRUCTURAL

Tunnels and Basement

On tunnel roof slab in front of Main House, restrict vehicle weight and payload to 6,000 pounds or less.

Provide means to prevent unauthorized vehicles from traveling over tunnel between Main House and swimming pool.

Replace timbers over opening at front porch of Main House with a concrete cover, designed to be a removable system (reversible treatment), and sealed to keep rainwater out of tunnel.

Replace and seal expansion joints in tunnel slab roofs and walls, seal other joints.

Treat exposed and exfoliated steel reinforcing in concrete elements, such as the tunnel roof slabs. Replace missing or deteriorated concrete.

Treat brick Great Hall fountain foundation (included in brick chapter).

Provide sealed closure, designed to be a removable system (reversible treatment), at uncompleted tunnel ends; remove excess soil and debris in tunnels.

On main tunnel drainage and utility trenches, replace missing or deteriorated cover planks.

Flag Tower

Re-anchor exterior ladder rungs. Apply abrasive safety coating to rungs.

Provide safety climbing pole at exterior ladder, with safety harness.

Exterior Features

Treat concrete slab at rear of Annex (from rear exit at Guest Bedrooms) to stop concrete deterioration.

Apply sealant to exposed exterior concrete slabs over tunnels. (Also see drainage chapter).

Restore eroded grades around foundations and exterior slabs (included in drainage chapter).

Veranda Roof

Restore veranda roof, Main House front porch.

Bridge

Limit bridge loading as recommended, including maximum of 19 people in tour groups. (See memorandum in Appendix of structural chapter). [Limit policy adopted and instituted in 1990.]

General

Repair deterioration and failures at Flag Tower concrete door hinges and steel stair connection to landing.

Repair or replace plaster and cork lining assembly where deteriorated or it has failed in Refrigeration and Freezer Rooms, Annex.

Replace/repair bottom stair support framing, Main House stair, first to second floor.

Treat exposed wooden decks, such as balcony floors, Main House, with water repellant.

SEISMIC

Continue seismic monitoring. Request that monitoring data be provided on an annual basis and that data include MMI for events, accelerograms and data detail.

Install expansion joints in exterior stucco system at selected locations (see stucco chapter).

When major stucco repairs are required, assess framing for seismic strengthening.

CONCRETE

Monitor Main House basement walls for moisture leakage and dampness (see drainage chapter).

Modify drain pipes in main tunnel roof slab between Main House and swimming pool to prevent ponding and concrete deterioration. Connect drains to tunnel drain piping. (Also see drainage chapter.)

Replace and seal expansion joints in concrete slabs. Treat rusted and exfoliated reinforcing and replace missing or deteriorated concrete. Repair miscellaneous concrete damage in tunnels, and repair or seal cracks or joints.

Provide moisture sealant on exposed concrete slabs. Maintain the historic unfinished appearance. (Also see structural chapter).

Repair concrete slab at rear of Annex, including treatment of exposed rusted reinforcing and patch concrete, and provide new protective topping.

Replace the safety barrier along the swimming pool and repair the holes previously bored in the tunnel top slab.

Provide protective treatment of exposed steel concrete reinforcing or other exposed steel which remains from the historic uncompleted construction.

BRICK

Great Hall Fountain Foundation

Inspect and test brick and mortar strength and stability utilizing core borings and lab testing. Determine treatment requirements.

Assuming consolidation is required, carry out treatment. Replace/repair deteriorated surface brick and mortar as required.

STUCCO AND PLASTER

Continue on-going park based stucco research.

Provide stabilization or reattachment of delaminated or severely damaged stucco on a limited basis only for safety or temporary protective concerns.

Replace delaminated and damaged stucco and plaster. Areas of highest priority are portions of the Annex north wall and south walls, and the ceiling and east wall of the Alcove. The Annex Freezer and Refrigerator Rooms are of lower priority; they are not yet interpreted and should not be treated until the second floor deck treatment is accomplished.

Repair and eliminate sources of moisture intrusion, such as leakage and poor drainage of the Annex second floor decks, the Lanai fountain and drains, and the Bridge. (See annex second floor deck, fountains and tile chapters).

Provide protective maintenance of large stucco cracks.

Install expansion joints at selected locations: Bridge to building intersections, intersection of Patio walls with buildings (inside corners only), and at back wall of Annex.

Clean exterior stucco only when needed and with low pressure water. (Do not attempt to remove rust stains). Clean interior plaster gently with vacuum.

Provide Munsell color record of original stucco and plaster colors. Use original colors for major sections of replacement stucco. For small repairs, match the existing adjacent stucco color.

TILE

Exterior Tile

Replace missing and damaged roofing tile with matching reproduction or salvaged tile. Replace/repair setting mortar as required. Includes obtaining equipment for protection of roofing and working platforms to minimize additional roof loading.

Inspect roofing tile, especially at eaves, at least annually, and after major storms.

RegROUT Patio tile as required to prevent grout loss, loose tile, and deterioration of setting mortar and substrate materials.

Clean and repair the drains in the Patio planter boxes as required; repair concrete where required and renew or add waterproofing; reduce the soil level in the planter boxes; regROUT planter box edging tile; renew the grout trim between the patio tile and planter box edging tile; replace deteriorated planter box edging tiles when necessary and available.

At the Patio/Annex alcove intersection, take up the paving tile as necessary, determine the requirements for expansion joints and install as required, reset the drain body as required, and reset and regROUT the tile paving.

Point the joint at the underside of projecting tile on porches and steps where the concrete wall or riser was not tiled to reduce water penetration into the tile setting bed. At porches, maintain grade a minimum of 2 inches below this joint.

Renew and maintain joint grouting of wall and parapet copings, making sure tiles are firmly set. RegROUT bridge tilework. Install mortar cap protection at vent location in parapet on south balcony of Annex.

In conjunction with Annex stucco and Lanai fountain repair projects, reset the tile of the Lanai and balcony decks to provide positive drainage away from walls and parapets and to drains.

It is noted that all tile joint grouting renewal and sound tile system maintenance is also prevention of safety hazards which would otherwise exist with broken and missing grout and loose tiles.

Interior Tile

RegROUT floor tile as required, reset loose tile as necessary, in heavy foot traffic locations before deficiencies cause tile breakage or a safety hazard. The location that should be repaired in the near future is on the balcony of the Great Hall near the doorway to the bridge.

Replace deteriorated, broken and missing grouting. Replace broken or missing tiles using existing stock when available provided that such stock is greater than the established minimum samples to be maintained in the collection.

Replacement of cracked, chipped or pitted tiles is not recommended unless they become so damaged as to create a safety hazard or cause deterioration of adjacent tilework. Patching of chipped or pitted tile is not recommended.

ANNEX SECOND FLOOR PATIO

Take up tile deck and tile wall base trim, seal concrete slab with a waterproof membrane (liquid applied type), repair/replace deck drains, and reinstall tile providing a carefully controlled setting bed to establish positive drainage for all deck areas. Repair/replace Lanai fountain plumbing system. Replace/restore fountain tilework.

OBSERVATION TOWER DECK

Replace deteriorated and leaking decking system, repairing or replacing deteriorated substrate materials as required.

WOOD

Clean wood with gentle means appropriate for the type of finish.

Continue on-going park based wood maintenance, restoration and repair, giving priority to exterior wood elements subject to high weathering and damaged wood subject to further damage by use. Provide record of materials, methods and finishes used.

Provide climate control for preservation of wood and all other fabric of the structures and furnishings. (See climate control chapter).

Remove and control conditions which induce rot or insect damage (maintaining grade to wood separation, insect control, etc.).

Provide analysis of wood color and finish systems and Munsell color record by conservator/specialist.

METALS AND GLASS

Obtain a metals finishes and color conservator/specialist for an analysis and record of metal finishes and colors.

Restore and refinish deteriorated door hardware finishes. Repair malfunctioning, damaged or worn components.

Refinish exterior metal windows, reglaze as required. Refinish metal grills and shutter hardware which has lost its finish.

Refinish weathered exterior structural elements such as the decorative supports of the Main House front porch veranda roof (also see structural chapter) and other structural or architectural elements having deteriorated finishes.

Repair and refinish exterior light fixtures as required.

COLOR

When treatment of wood, metals or other materials is undertaken, part of the preparatory analysis is to determine the aspects of the finish system, what materials were used, what colors and how it was done. A color analysis should be undertaken for both wood and metal elements as recommended in those chapters of this report.

ENVIRONMENTAL CONTROLS

A staged climate control improvement program is recommended, consisting of interim improvements overlapping with the design and implementation of a permanent new system, whose components would be installed incrementally. The proposals are formulated so that there can be a better likelihood of accomplishment under limited annual funding, and can be installed primarily by park staff so work can be controlled to minimize impacts on building fabric.

The following interim measures are recommended for implementation:

1. Improvements to the Building Envelope
2. Improvements to the Existing Heating System
3. Upgrade Existing Humidifiers

As funding becomes available for the design and construction of a comprehensive climate control system, it is recommended that the existing heating system be deactivated in stages and all of

the existing humidifiers be removed in stages. It is recommended that these systems be replaced with a comprehensive, individual zone, heating, ventilating, and air conditioning system consisting of package-type water source heat pumps with electric (electrode boiler type) humidifiers. It is also recommended that this system be installed primarily by the park staff using day labor. The nature and configuration of this system is such that it may be installed in stages as funding allows.

The recommended implementation sequence is proposed as a multiple year effort, the total number of years subject to annual funding levels:

1. Develop the designs for interim improvements (building envelope and existing heating system and humidification) and perform a curatorial study to refine indoor design criteria for building and object preservation.
2. Implement improvements to the building envelope and the existing heating system. Prepare a complete design for the recommended comprehensive climate control system. Conduct compliance review of the total design package.
3. Install water supply piping, drainage piping, electrical conduit, and main electrical distribution for the recommended comprehensive climate control system.
4. Install new system components zone by zone as annual funding permits.

FIRE SUPPRESSION

A feasibility study is recommended to determine whether a fire suppression system could be installed in the Main House and Annex with minimum fabric impact and minimum visual intrusion, so that, in conjunction with the recommended upgrading and expansion of the existing detection system, a level of protection would be achieved that would justify installation of a suppression system.

PLUMBING

The historic plumbing system will be left in place but those sections which are not required for normal operations should be deactivated to decrease the potential for leakage in deteriorated piping, which in turn could damage building fabric or furnishings. It is recommended that sections of the system not used or needed be isolated to prevent further corrosion and deterioration.

FOUNTAINS

Jasper Fountain, Great Hall

Assuming the recommended climate control system is implemented, the fountain will not be required for humidification. The reason for restoring the fountain to operable condition will be to restore the historic ambiance of the room. Several potential treatment options should be explored before undertaking a complete rebuilding of the fountain: determine the feasibility of a chemical sealer for the stone, or the insertion of a liner behind the stone. If neither are viable

and restoration is still prescribed, restoration will include the recommended treatments of replacement of the stonework in kind, a new liner system, replacement framing, and replacement plumbing with flow regulators and controls.

Restore Solarium Fountain

The basis for restoration should be similar to that for the Great Hall fountain. Assuming the decision for restoration, replace the plumbing adding flow regulators and controls, replace liners and moisture barriers, replace deteriorated structural and framing elements and substrates, replace damaged plaster, and restore the tilework by replacing the grout and retaining the existing tile.

Restore Lanai Fountain

Because this fountain is outdoors, deterioration will continue if it is not restored. The fountain and tile deck restoration should be done at the same time. The fountain restoration is recommended to include replacement of normally inaccessible plumbing with plastic pipe, adding flow regulators and controls, and duplicating and replacing the tilework. (Place original tile in the artifact collection).

Restore Entry Court Wishing Well

This fountain should also be restored since it is also outdoors and will continue to deteriorate if not treated. Replace all plumbing, using plastic piping in normally inaccessible locations and adding flow regulators and controls, provide moisture barriers, repair tilework and grout as necessary, replace tiles where required, clean and restore the metal element and provide a protective coating.

COURTYARD ARBOR

Reconstruction of the arbor would be consistent with the interpretation and restoration policy and thus supportable. However, it is suggested that it be regarded as a low priority, except as it may relate to one of the methods of improving building climate control to reduce temperatures within the buildings.

ELECTRICAL SYSTEM ASSESSMENT

The building electrical distribution systems were upgraded in recent years and are in good condition. Only a few minor corrections are recommended. Corrections to the site primary power supply have already been recommended during the course of this study. As part of the implementation of the climate control program recommended in this report, expansion of the primary power supply will be required and is recommended, along with distribution to the climate control equipment.

FIRE DETECTION AND SECURITY SYSTEMS ASSESSMENT

The existing intrusion and fire detection systems are also recent installations and are in good condition. Some improvements and additions are recommended, some of which the park has already undertaken. The control and monitoring units are recommended to be replaced in the future.

TREATMENT STRATEGY AND PHASING

Implementation of the recommended treatments will require a flexible strategy to meet changing funding and all the other functional activities at Scotty's Castle. Normal maintenance, curatorial and interpretive programs are interrelated with the preservation program in order to keep the resource open to the public. The influences will vary considerably. Much of the exterior work will not have a great affect on curatorial or interpretive operations. On the other hand, interior work will have varying degrees of influence on curatorial and interpretive operations. In some cases, for example, tour routings and even presentations may be greatly affected.

Annual work programs will need to be developed, or at least reviewed and revised, to coordinate protective storage for furnishings, to be sure that adequate personnel will be available for moving furnishings and to conduct the work.

Because funding is expected to be available only in small annual increments, as opposed to only one or several large allocations; because control of the quality of workmanship and protection of building fabric is extremely important; and because outside contractor costs are very high due to the remoteness of the site and the shortage of park housing; most of the recommended treatments are proposed to be implemented by park based preservation crews. This is reflected in the cost estimates and the annual sample work program.

To support and properly execute the preservation treatment program it is important to initiate several documentary and design elements:

1. Since environmental control is the highest priority, system design must also be of equal priority. (This has been undertaken with funding allocated in FY 91 for design development, and funding proposed for FY 92 targeted for construction drawings and specifications.)
2. Related to the overall environmental control program is a detailed assessment of conservation needs for both furnishings and building materials. Because of the wide range of climate control needs for the multitude of furnishings and building materials, an average must be used. Some critical furnishings items may need special control or separate curatorial measures.
3. An analysis is needed to determine the feasibility of providing a fire suppression system. If feasibility is shown, design and installation should be in conjunction with that for the climate control system to coordinate major piping routes for both systems to reduce fabric impact.
4. For treatment of stucco, plaster, wood and hardware, a complete analysis is needed to record colors, coloring agents, and finish materials (historic and recommended modern products) to accurately repair or reproduce finishes.

PRIORITY EVALUATION

Factors and Values

1. Significance: Character defining features; uniqueness
Landmark/NR = 10; Reg./Local = 5; None = 0
2. Documentation
Good = 3; Moderate = 2; Low = 1; None = 0

3. Condition
Not Safe = 10-9; Poor = 8-7; Fair = 6-4; Good = 3-1
4. Integrity
Deterioration, failure = 10-8; Moderate deterioration, missing elements = 7-5; Well preserved = 4-0
5. Interpretive Value
Direct = 5-4; Potential or indirect = 3-2; Not likely = 1
6. Visual Value
High = 10-8; Moderate = 7-5; Low = 4-1
7. Threat (if not treated)
Severe (2 years) = 5-4; Moderate (5 years) = 3-2; Low = 1-0
8. Impact (of treatment): Preserve, replace, add system
Positive (high value) = 5-4; Moderate = 3-2; Negative (low value) = 1-0
9. Reversibility
Total = 5-4; Partial = 3-2; None = 1-0
10. Compatibility: Fabric, scene, behavior
Good = 5-4; Compromise = 3-1; Incompatible = 0
11. Operational Requirements: Codes, policy, special needs
Required = 5-4; Optimum = 3-2; Desired = 1
12. Implementation: Skills availability, scheduling, housing
Requires planning, coordination
Critical = 5-4; Flexible = 3-2; Independent = 1
13. Maintenance Considerations: Cost, frequency, skills availability
Little change (most desirable) = 5-4; Moderate = 3-2; High, critical (least desirable) = 1-0
14. Treatment Cost
High = 5-4; Moderate = 3-2; Low = 1
(High priority for high cost items because cost will become greater in the future).
15. Related Work
Critical = 5-4; Flexible = 3-2; Independent = 1

TABLE OF PRIORITIES

	Env	E Wd	I Wd	Pstr	I Tl	Mtl	Stu	Roof	Bric	Deck	Ftn	E Tl	Str	Dm	Conc	Arbr	Pst
Significance	* 10	10	10	10	10	10	10	10	5	10	10	10	5	0	5	10	0
Documentat'n	2	2	2	2	2	1	2	2	2	2	2	2	2	3	3	3	2
Condition	* 10	7	2	2	2	5	4	5	5	8	9	6	3	8	4	na	9
Integrity	* 10	8	3	2	2	5	7	7	6	8	9	5	4	8	6	10	8
Interp Val	* 5	2	3	3	3	3	2	1	0	1	5	3	1	0	1	3	0
Visual Val	* 10	9	10	10	10	10	10	10	1	10	10	10	1	1	5	9	0
Threat	5	5	2	2	2	2	4	5	2	5	2	4	2	3	4	0	5
Impact	5	5	3	3	3	4	5	5	3	5	5	5	4	5	4	3	5
Reversible	3	2	2	3	3	3	3	2	2	2	2	3	2	2	2	5	0
Compatible	3	4	4	4	4	4	4	4	4	3	2	4	3	4	3	5	2
Oper Req	5	4	3	3	3	4	5	5	2	5	2	4	3	4	3	1	5
Implement	5	5	4	4	3	2	2	3	2	3	4	2	1	3	2	1	5
Maint Impl	1	4	4	4	4	4	4	4	4	4	3	4	3	4	4	0	4
Treat Cost	3	3	3	3	3	4	3	5	2	5	5	3	2	3	2	4	3
Related Work	5	1	4	4	4	4	2	2	1	3	1	1	1	2	1	1	1
Total	82	71	59	59	58	65	68	70	41	74	71	66	37	50	49	55	49
Priority	1	3	8	8	9	7	5	4	13	2	3	6	14	11	12	10	12
	Env	E Wd	I Wd	Pstr	I Tl	Mtl	Stu	Roof	Bric	Deck	Ftn	E Tl	Str	Dm	Conc	Arbr	Pst

Env = Environmental Control
 Mtl = Metals and Glass
 Ftn = Fountains
 Arbr = Courtyard Arbor
 E Wd = Exterior Wood
 Stu = Stucco
 E Tl = Exterior Tile
 Pst = Pest Control
 I Wd = Interior Wood
 Roof = Roof Systems
 Str = Structural
 I Tl = Interior Tile
 Deck = Annex 2nd Floor Deck
 Conc = Concrete
 Pstr = Plaster
 Bric = Brick
 Dm = Site Drainage

* Protects significant features; Lack of environmental control threatens condition, integrity, interpretive and visual values.

COST ESTIMATE

The costs for the recommended treatments have been estimated, in most cases, using time and materials because standard costing data does not fit much of the requirements of this project. Many material costs will be high because of the need for specially ordered reproductions. Labor costs are based on park based preservation construction crews, using approximate 1991 Wage Grade scales, benefits and overhead. The various hourly or crew rates are rounded upward.

A summary of the estimated costs follows, both in a list form by major category of work and in a table showing a sample program of the work done in a ten year period. The cost calculations are appended.

The table is a sample program and should be regarded as such. Various conditions, including funding availability, will vary from year to year. Thus any annual work program will need to be developed based on work progress, labor availability, fund expectations, other park programs and other factors that cannot be foreseen.

ESTIMATED COSTS SUMMARY

To support the preservation program, analysis and design priorities are recommended for Climate Control System Design, Fire Suppression Analysis, Furnishings and Materials Conservation Assessment, and Color and Finishes Analysis. Estimates by Denver Service Center, calculated for 1991 (see appendix); for later years, add annual escalation.

Storm Drainage

Regrade/resurface Entry Court	\$ 55,100
Modify pool tunnel slab drains, add piping	11,950
Restore grades, Main House foundation, porches	1,950
Regrade west & north of Castle	18,667
Regrade hillside	<u>3,250</u>
	\$ 90,917

Structural

Replace opening cover, Main House, front porch	\$ 1,700
Replace/repair concrete joints, tunnels	9,250
Concrete/reinforcing treatment/repairs	19,000
Tunnel end enclosures	13,000
Utility trench cover planks	1,900
Flag tower ladder repairs	8,700
Flag tower ladder safety equipment	12,500
Concrete slab moisture protection	4,860
Restore veranda roof	27,540
Flag tower door and stair repairs	8,200
Refrigeration/Freezer rooms plaster replacement	68,956
Main House stair repair	6,900
Moisture protection, wood balcony floors	<u>750</u>
	\$ 183,256

Concrete

Replace swimming pool safety barrier	\$ 32,000
Moisture protection, exposed concrete reinforcing	<u>9,000</u>
	\$ 41,000

Brick

Brick foundation treatment, Jasper Fountain	\$ 25,000
	<u>\$ 25,000</u>

Interior Work Preparation

Furniture moving, storage	\$ 139,200
	<u>\$ 139,200</u>

Stucco and Plaster

Exterior stucco replacement, Annex	\$ 62,770
General exterior stucco repairs	50,000
Moisture protection, large stucco cracks	10,000
Stucco expansion joints	8,850
General interior plaster repairs	<u>125,000</u>
	\$ 256,620

Tile

Repair tile roofing	\$ 92,750
RegROUT exterior paving tile, Patio, Alcove, etc.	51,120
Repair paving, Patio/Alcove intersection	6,100
Repair drains, etc., Patio planters	13,650
Mortar joint repairs, porch edges	4,000
RegROUT tile, copings, bridge	8,000
Annex Lanai, deck paving, drains, fountain restoration	76,235
Interior tile repairs	<u>76,000</u>
	\$ 327,855

Observation Tower Deck

Replace deck	\$ 12,900
	<u>\$ 12,900</u>

Wood

Exterior wood restoration/repair	\$ 264,000
Interior wood restoration/repair	306,900
Soil/wood separation, insect control	<u>6,500</u>
	\$ 577,400

Metal and Glass

Restore door hardware	\$ 68,400
Restore metal windows, grills, shutter hardware	103,930
Restore exterior metal features	20,400
Restore exterior light fixtures	<u>20,400</u>
	\$ 213,130

Color

Finish/color analysis	<u>\$ 116,424</u>
	\$ 116,424

Climate Control

Existing heating system improvements	\$ 5,449
Building envelope weatherization	12,375
Fire isolation doors and dampers	13,971
Comprehensive climate control system	308,064
Furnishings/materials conservation assessment	45,000
Construction documents	<u>55,000</u>
	\$ 439,859

Fire Suppression System

Fire Suppression Analysis	<u>\$ 35,000</u>
	\$ 35,000

Plumbing System

Deactivate/isolate unused system sections	<u>\$ 5,500</u>
	\$ 5,500

Fountains

Restore Great Hall (Jasper) fountain	\$ 42,500
Restore Solarium fountain	15,730
Restore Entry Court fountain (wishing well)	<u>22,000</u>
	\$ 80,230

Courtyard Arbor

Reconstruct arbor	<u>\$ 40,000</u>
	\$ 40,000

Electrical System

Upgrade electrical system capacity	\$ 11,725
Future emergency generator	<u>\$ 80,000</u>
	\$ 91,725

Fire Detection and Security Systems

Upgrade fire detection and security system	<u>\$ 41,000</u>
	\$ 41,000

Total Estimated Construction Costs	\$ 2,465,592
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Total Estimated Design and Analysis Costs	\$ 251,000
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TABLE OF ESTIMATED CONSTRUCTION COSTS/SAMPLE PROGRAM

Amounts in 1991 dollars.

Design/Advance Planning Costs not included in table: Climate Control System Design = \$ 55,000; Fire Suppression Analysis = \$ 35,000; Furnishings/Materials Conservation Assessment = \$ 45,000; Color/Finishes Analysis = \$ 116,000.

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Cli Contr 80,776	Cli Contr 69,052	Cli Contr 48,552	Cli Contr 48,551	Cli Contr 48,551	Cli Contr 48,551	Cli Contr 48,551				392,584
Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	Ext Wood 26,400	264,000
Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	Int Prep 13,920	139,200
Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	Int Wood 30,690	306,900
Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	Int Plast 12,500	125,000
Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	Int Tile 7,600	76,000
D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	D/W Metal 17,233	172,330
Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	Ext Stucco 13,162	131,620
	Ver Roof 27,540	Roof 28,750	Roof 32,000	Roof 32,000	Obs Deck 12,900		R/F Plast 68,956			202,146
	Brick 25,000	A Deck/Ftn 76,235	S Ftn 15,730	Ext Tile 23,074	Ext Tile 23,074	Ext Tile 23,072	Ext Metal 20,400	E Lgt Fit 20,400		226,985
	Soil/Pests 6,500	G H Ftn 42,500	P Plant 13,650	Struct 36,300	S Drain 55,100	S Drain 11,950	S Drain 23,867	Pool Rail 32,000	Arbor 40,000	261,867
	Conc 10,950	Conc 19,000	Conc/Mtr 11,650	Conc 17,860	Plumb 5,500	Wish Well 22,000			Em E Gen 80,000	166,960
202,281	260,547	336,542	243,086	279,290	266,630	227,078	234,728	173,905	241,505	2,465,592

TREATMENT EFFECTS EVALUATION

EVALUATION CRITERIA

The determinations of effects of recommended treatments are made in accordance with Section 36 CFR 800.3 of the Advisory Council on Historic Preservation's "criteria of effect." The following are excerpts from NPS-28¹⁴⁴ on compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

The Advisory Council's criteria of effect require the Service to take a broad view of effect and the associated range of casual actions. Effect follows not only from actions having a direct physical impact on cultural resources and taken to preserve, modify, or use them, but also from an undertaking near a cultural resource, inside or outside a park or National Register boundary, that may introduce "visual, audible, or atmospheric elements that are out of character with the property or alter its setting."

Application of the criteria will yield one of the following findings for a project [or recommendations]: no effect, no adverse effect, or adverse effect.

EVALUATION IN PREVIOUS DOCUMENTS

Preservation treatment effects were recognized in the National Register nomination. The following are excerpts from the National Register nomination, dated July 20, 1978 (date of listing), accompanied by commentary or explanation derived from findings of this report:

A tiled courtyard between the two structures [Main House and Annex] was originally covered with eucalyptus logs to provide a sun screen and grape arbor. These have been removed. However, there are plans to replace them in the near future.

Comment: The arbor was undoubtedly removed because of its deterioration; possible failure would have been a safety hazard. Replacement would restore the historic scene. Priority for implementation would be low but is enhanced as the arbor would provide some cooling benefit for the courtyard and buildings.

The Main House and Annex are in need of extensive repairs, although the buildings seem to be structurally sound, and all environmental control systems need to be completely replaced or substantially overhauled....

Johnson used several types of construction techniques and some innovative materials, the combination of which has caused certain structural problems. The major materials and construction types include reinforced concrete, wood frame, hollow building tile, "Insulux" foam insulation and stucco. The problems are spalling concrete, cracked stucco, stucco and mesh backing separating from the structure, broken tiles, and advanced deterioration in the environmental control systems. Essentially all the environmental control systems for the Castle will have to be renovated.

144. NPS-28, Cultural Resources Management Guideline, Release No. 3, August 1985, Chapter 4, page 3.

Comment: In general, the buildings are structurally sound. Architectural materials do require extensive treatment, ranging from preservation actions to replacement. Although the existing (historic) heating system is functional, it is inadequate and recent failures have damaged building fabric. Although portable humidifier and dehumidifier units have been utilized in recent years, environmental control is not integrated and remains inadequate.

The critical elements needing protection here that are essential to the historic district are those dealing with the architecture, the technological concerns, the historic scene and the historic interior decoration and furnishing. The exteriors of all the structures should be returned to their appearances at the time of the halt of construction in 1931.¹⁴⁵ This would include the removal of all non-historic additions...[additions to the curio shop and cookhouse]. The interiors of the buildings which have been altered, such as the Hacienda and cookhouse, should retain as much of their original character as possible. This would include protection of the obvious architectural and decorative elements of the original design, or built during the period of historic significance (1922-1931). The architectural and decorative elements protected here are those such as beams and ceiling work, wrought-iron, tilework, built-in lamps and other appliances. This does not preclude development of interiors which are not of architectural significance (the basement of the Hacienda, the kitchen area of the cookhouse, the interior of the motel-garage unit), nor does it preclude interior adaptive restoration in the lesser important but nonetheless architecturally or historically significant areas, as long as those features are preserved. This does preclude changes other than restoration to the Main House and second story of the Annex, the Powerhouse, and the Chimes Tower.

The interior decoration and furnishing in the buildings are an integral part of the significance, since every piece was specifically made for or chosen for the Castle.

Among the proposals of the draft Interpretive Prospectus (February 1989) one of the objectives stated is "to effectively exhibit more of the original furnishings and artifacts." (Also see the building uses chapter of this report.) For the Main House and Annex it is proposed to eventually exhibit the spaces, furnishings and equipment in Mrs. Johnson's Apartment, Mr. Johnson's Office, and the refrigeration and freezer rooms. With the exception of the basement of the Main House and the Annex first floor, all the rooms of both buildings are presently exhibited.

Other specific proposals found in the Interpretive Prospectus are:

Strong consideration should be given to providing as much additional controlled light in several of the darker furnished rooms of the Castle *as would be consistent with*

145. The interpretive and preservation period was redefined in the Record of Decision for the GMP/FEIS, April 18, 1989:

The interpretive period for furnishing the first and second floors of the main house and the second floor of the annex is 1934 through 1941. This does not preclude, however, the use of earlier or later data where none exists for the interpretive period. The structure exteriors and grounds of Scotty's Castle will be managed and preserved as they appeared during the early 1950s through Scotty's death in 1954, including alterations made to Windy Point for his burial and the grave site memorials which followed. With respect to the historic resource study/historic structure report, the study would also determine other possible periods of significance for the structures and grounds at the Castle and Lower Vine Ranch.

responsible furnishings and artifact care. It would seem particularly appropriate to brighten the octagonal Solarium.

Comment: Although a higher light level would be desirable for viewing the rooms and furnishings, it is not desirable in terms of protection of leather, cloth and other materials above the curatorial standards which have been established. The addition of artificial lighting is discouraged to keep building fabric impacts to a minimum. If after testing light levels, some portable fixtures might be considered in limited locations if determined to be appropriate. More appropriate would be slight adjustment of draperies to admit more light in conjunction with shutter positions to block direct sunlight.

The courtyard between the Main House and the Annex should be refurnished with custom reproductions, and have its overhead eucalyptus log trellis reinstalled.¹⁴⁶

PRESERVATION/CONSERVATION PHILOSOPHY

As may be found often in this Historic Structure Report, a "no action" alternative is not addressed. As is often the case, preservation is the objective and if no action would be detrimental to the fabric, then no action is obviously not desired nor recommended since it would be an adverse effect. Thus the recommended action is toward preservation or restoration, which will normally be targeted to have a beneficial effect, and at a minimum no adverse effect. Actions which may have an adverse effect are avoided unless no reasonable alternative is available, or is temporary and can be restored or reversed.

Actions which are of net benefit to preservation of the resource may involve "sub-actions" which might be considered adverse effects in order to achieve the desired treatment or resource protection. To protect the buildings and their contents from the deteriorating effects of weather and water leakage, for example, removal of broken roofing tile, rotted wood, or failing stucco is adverse, but these actions must be done for long-term protection of the resources. Such materials are considered the protective shell and have to be replaced as they wear out.

Architectural finishes (paints, clear coatings and other finishes) are usually considered to be sacrificial and to have a limited life span. Normally they are renewed by recoating or replacing. There are occasions, however, where the finish is so unique or of a specific decorative quality that it will be warranted significant enough for conservation, such as in murals or stenciling.¹⁴⁷

Scotty's Castle does have finishes that are of a uniqueness or significance that conservation should be undertaken rather than renewal. These are usually found in interior spaces. On the other hand, exterior materials and finishes are more of the renewable or "sacrificial" type. The finish textures of the exterior stucco of Scotty's Castle are unique and the material should be preserved as long as possible but not at the expense of damage to substrates, and ultimately will have to be replaced.

146. Interpretive Prospectus (Draft), Death Valley National Monument, February 1989, pp. 20-21.

147. See for example Zucker, Joyce and Deborah Gordon, "Decorative Finishes, Aspects of Conservation and Cleaning", in "The Interiors Handbook for Historic Buildings", Edited by Charles E. Fisher, III, Michael Auer and Anne Grimmer, Historic Preservation Foundation, Washington, D.C., 1988. Also see bibliography of that article.

In most cases it will probably be appropriate to preserve, restore or replace fabric with finishes matched to the original. There are unusual cases, however. An example of a unique problem is the exterior stucco pattern on portions of the Cook House, which were later additions to the building but built within the historic period. The stucco texture pattern is "incorrect" in relation to the original textures, an example of how the original skill was "lost". Even though it does not match the original textures, when repair or replacement is necessary this "incorrect" texture will need to be reproduced to preserve the proper time context of these building additions and material treatments.

On the other hand, where repairs or replacements are necessary, the original finish, texture and color should be reproduced. This is true also where past repairs were made but done incorrectly, unless the repair in itself has historic significance.

In the paragraphs below pertaining to architectural materials and coatings, these are coded as a guide for identifying the treatment approach that would normally be used in terms of the level of effort appropriate relative to its importance, uniqueness or the feasibility for preservation. Note that there are two categories: (M) finish materials, and (C) finish coatings. Note also that certain materials or coatings occur only in an exterior (E) or interior (I) context, but some can occur in either.

ASSESSMENT OF RECOMMENDED TREATMENTS

Tile

Roofing Tile (M), (E). Broken or deteriorated tile cannot be repaired but must be replaced. No adverse effect.

Paving Tiles (M), (E, I). Broken, cracked or deteriorated tile cannot be repaired and will have to be replaced. An interior cracked tile can be retained as long as it is stable, unless it allows water intrusion or is a safety hazard, but if in an exterior location it should normally be replaced as soon as possible to prevent water intrusion detrimental to substrate materials. No adverse effect.

Decorative Tiles (M), (E, I). In some cases, consolidants may provide temporary stabilization for early stages of surface deterioration and protection but probably not permanent repair. Replacement will usually be necessary. No adverse effect.

Tile Treatment Findings. No adverse effect.

Stucco and Plaster

Stucco (M), (E). On a case by case basis, some problems can be stabilized or repaired; in other instances replacement would be required. Stucco should be preserved as long as possible, but eventually much stucco will be replaced as a "sacrificial" surface. No adverse effect.

Interior Plaster (M), (I). Interior plasters will have a much longer life than exterior stucco. Stabilization or repair will also be more often possible than for exterior stucco. Interior plaster finishes are unique and conservation measures will be appropriate. No adverse effect.

Stucco and Plaster Treatment Findings. No adverse effect.

Wood

Wood (M), (E). Exterior wood elements are heavily impacted by the harsh environment and suffer from degradation by ultraviolet light, extreme heat and dryness, erosion by windblown dust, rot, and attack by insects. Severely deteriorated elements need to be replaced. Recent efforts have shown promise for repair treatments that will permit retention of much original deteriorated wood provided that funding will enable the preservation staff to progress with treatment and to "catch up", reaching a maintenance level. No adverse effect. Once the maintenance level is achieved, preservation can only be accomplished with an adequate level of maintenance commitment or the degeneration cycle will only occur again.

Wood (M), (I). Interior wood elements are more protected than those of the exterior and show less distress but have suffered from the extreme heat and dryness to the extent that these character defining features are endangered by failure from lack of proper interior climate control, as are furnishings and artifacts. (Adverse effect). Thus this report advocates the installation of a climate control system (evaluated below). A variety of "minor" repairs caused by the various aspects of use are needed but are a lower priority but must be done before severe damage occurs. No adverse effect.

Wood Treatment Findings. No adverse effect.

Material Finishes

Clear Wood Finishes (C), (E). Exterior clear wood finishes need to be renewed periodically to protect the wood. Where these finishes have high sun and weather exposure, renewal is necessary at more frequent intervals than if in protected locations. The same is true for replacement intervals. No adverse effect.

Clear Wood Finishes (C), (I). Interior clear wood finishes last much longer than exterior finishes, so the renewal or replacement interval will be considerably longer but will vary depending on the type of surface. Wearing surfaces such as doors need renewal more often than most other surfaces. Quite often a stain was used in conjunction with a clear finish. A record of stain colors and finish materials is needed for proper treatment when replacement is needed. No adverse effect.

Stained Wood Finishes (C), (I). Many interior wood surfaces were stained but often do not appear to have received a clear coating. These are characteristically ceiling boards and decorative beams which are normally not subject to wear. Such surfaces will rarely need renewal. A conservation approach should be taken. A record of stain colors and finish details needs to be compiled. No adverse effect.

Paint, Exterior (C), (E). Renew or replace periodically to protect the substrate material, such as metal window sash. No adverse effect.

Paint, Interior on Plaster (C), (I). Stenciled designs on bathroom walls are unique and conservation measures should be utilized to preserve them. No adverse effect.

Paint, Interior, On Carved Wood (C) (I). Paint or stain highlighting in carved wood designs occur in a number of locations, such as the bookcases in the southeast alcove of the Living Hall, the mottoes in the Lower Music Room, carving in beams such as in the Solarium or Upper Music Room. These are unique treatments and a record needs to be prepared of original techniques, colors and color intensity. Conservation treatment may be necessary to preserve these details after determination of their characteristics. No adverse effect.

Material Finishes Treatment Findings. No adverse effect.

Metals and Glass Preservation

Metals (M), (E, I). This category of material includes windows, door and shutter hardware, railings and lighting fixtures – among a variety of building functional and decorative elements. Some repairs are needed and the entire range of finish treatments, from maintenance to renewal. No adverse effect.

Glass (M), (E, I). Historic glass is most often associated with windows and lighting fixtures. Treatment is limited for the most part to replacement of missing, broken or previously replaced glass that is the incorrect type, texture or color. No adverse effect.

Metal Finishes (C), (E, I). The finish treatments of most metal elements, both exterior and interior, are unique and should be preserved as long as possible, which is more easily accomplished on interior items. Often exterior hardware finishes have deteriorated or completely weathered away and need to be reproduced. A record needs to be prepared, determining colors, methods and materials. No adverse effect.

Metals and Glass Treatment Findings. No adverse effect.

Concrete Preservation

Repair, stabilization and preservation treatments are needed to stop concrete deterioration caused primarily by water intrusion but also by tree root pressure and some mechanical damage. No adverse effect.

Concrete Treatment Findings. No adverse effect.

Brick Preservation

Stabilization, repair and some replacement of the brick portion of the Main House Living Hall fountain foundation is needed because of past water damage. No adverse effect.

Brick Treatment Findings. No adverse effect.

Storm Drainage

Storm drainage improvement proposals are: regrading and resurfacing the "entry court" area immediately east of the Main House and Annex and the historically unfinished Rose Garden

area west of these two structures. Ponding and negatively pitched areas cause water damage at building walls and seepage into various structural components of the site. In the process, resurfacing the entry court area is proposed to provide an appearance more visually compatible to the historic scene while providing the necessary accessible hard surface. (The historically unfinished area was gravel, which cannot be reproduced as it would inhibit accessibility and increase dust, detrimental to the buildings and furnishings.) Some minor regrading immediately around the structures is needed for positive drainage and erosion control. Collection of storm water in tunnels will decrease deteriorating effects of water and reduce insect infestation problems. Partial implementation of the latter has been accomplished. The unfinished ends of three utility tunnels need to be provided with bulkheads to keep drainage water out of the tunnels, which washes in dirt and debris and attracts insects. No adverse effect.

Storm Drainage Treatment Findings. No adverse effect.

Pest Management

Continue and enhance treatment for termites, carpenter bees and mud daubers. Obtain expert consultation on pesticide materials and treatment which will control insects without effects on building materials and meet goals for reduction or elimination of use of toxic chemicals. No adverse effect.

Pest Management Findings. No adverse effect.

Structural Treatments

Decrease number of persons in tour groups for load limit on bridge between Main House and Annex. Accomplished.

Repair and restore Main House front porch roof, second floor. Deteriorated materials and poor anchoring are threats of damage and loss from wind. No adverse effect.

Repair Annex Flag Tower access ladder. Loose anchorage of rungs are a safety hazard. Provide safety gear for staff use when ladder is used (for inspection of upper section of tower). No adverse effect.

Replace deteriorated stair support framing, Living Hall to Gallery stair, Main House. No adverse effect.

Structural Treatment Findings. No adverse effect.

Seismic

Continue seismic monitoring and arrange for additional monitoring data detail. Install expansion joints in exterior stucco at selected locations (see Stucco below) for movement and moisture protection. When major exterior stucco replacements are necessary, assess building framing for seismic strengthening.

Seismic Recommendations Findings. No adverse effect.

Annex Second Floor Patio

The tiled exterior patio areas of the second level of the Annex need a waterproof barrier to prevent water damage to the structure below, which has caused delamination and failure of ceiling and wall stucco in much of the first floor section of the building. This will require carefully taking up the tile paving and setting bed, installation of a moisture barrier, and reinstalling the tile in a setting bed pitched for good drainage. At the same time, the Lanai fountain, which is deteriorated and contributed to the stucco damage, will need to be restored (see Fountains below). No adverse effect.

Annex Second Floor Patio Treatment Findings. No adverse effect.

Observation Tower Deck

Deterioration of this exterior small wooden floor has caused leakage of wind driven rain and snow melt into the Main House below. The flooring and its flashing system need to be replaced so that it is visually duplicated but with improved flashing and moisture barrier systems. No adverse effect.

Observation Tower Deck Treatment Findings. No adverse effect.

Color and Finish Documentation

To properly treat wood and metal, an on-site analysis needs to be conducted to document all stain and paint colors. Laboratory chemical analysis is recommended to document finish materials used historically. On-site color analysis is recommended because of those situations where removal of samples would be a visible adverse effect. With careful investigation and selection of sampling locations, documentation can be accomplished with no adverse effect.

Color and Finish Documentation Findings. No adverse effect.

Environmental Controls

In order to provide climate control protection of the building fabric and the furnishings and artifacts exhibited in their interiors, some building fabric will need to be removed for installation of system elements -- ducts, registers, piping and controls. Removal of floor tiles or plaster for air distribution ducts and registers will be an adverse effect. Mitigation of these effects, however, will be not only by the careful design and layout of the system and control of the work, but the end result of long-term protection of the resources. The criteria for development of the system concept proposed are predicated on minimizing building fabric removal, placing registers in the least visible locations, minimizing the number of registers, minimizing building fabric disturbance for installation of the system, concealing ductwork, piping, conduit and equipment from public view, minimize fabric disturbance for anchoring equipment, and providing equipment and duct sound control. Whereas no action would be an overall adverse effect, achieving good resource protection can have some adverse impacts within the actions necessary to provide the end beneficial results.

Environmental Control Implementation Findings. No adverse effect.

Fire Suppression

A feasibility study is recommended to determine whether a fire suppression system could be installed in the Main House and Annex with minimum fabric impact and minimum visual intrusion. Determination of effect is dependent on the outcome of such analysis.

Plumbing System

Many portions of the building plumbing system are not in use. The only work proposed is to "mothball" these portions of the system to prevent or stop deterioration by disconnection and capping. No adverse effect.

Plumbing System Treatment Findings. No adverse effect.

Fountains

With implementation of the recommended climate control system, the humidity provided by the interior fountains will not be needed, although the additional humidity would decrease the humidification load (and increase the dehumidification load) of the system. Restoration of the operation of interior fountains would be based on restoring historic ambiance. Several treatment concept options for the Great Hall fountain need in-depth investigation to determine feasibility. The most extensive treatment option will be to replace deteriorated materials and systems, the stonework being the most difficult. The Solarium fountain needs replacement plumbing, repair or replacement of substrate or adjacent materials and mortar renewal, but all of the historic tile can probably be retained. Because of the extreme deterioration of the tile of the Lanai fountain, replacement in-kind will be required. The original tile and samples of all other materials will be retained in the building artifact collection. The entry court Wishing Well fountain needs replacement plumbing, which will require some removal and replacement work but the tile work would be retained in its present design. Although the removal of historic fabric is necessary to restore the fountains, the end result will have no adverse effect.

Fountains Treatment Findings. No adverse effect.

Courtyard Arbor

As previously noted, replacement would restore the historic scene. Priority for implementation would be low but is enhanced as the arbor would provide some cooling benefit for the courtyard and buildings and comfort for visitors. No adverse effect.

Courtyard Arbor Reconstruction Findings. No adverse effect.

Electrical, Fire Detection and Security Systems

In order to implement the environmental control proposed, additional electrical power capacity will need to be provided at the site and distributed to the equipment. The site utility tunnel system will make distribution easier than normally encountered. Distribution within the buildings will cause some fabric removal and patching work but systems conduit for the most part will be hidden.

Upgrading the existing fire detection and security systems is recommended but can be accomplished with little disruption of building fabric. No adverse effect.

Electrical, Fire Detection and Security Systems Improvements Findings. No adverse effect.

APPENDIXES

EXISTING CONDITIONS AND RECOMMENDATIONS

APPENDIX A, STRUCTURAL CALCULATIONS

FORM DSC-44

Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet	1
Area	SCOTTY'S CASTLE			of	2
Project	H.S.R.	By	Checked	Pkg.	
Feature	ALLOWABLE LOADS FOR CONCRETE SLAB BETWEEN HOUSE AND POOL	Date	Date	Account	

ALLOWABLE LOADS FOR CONCRETE
SLAB BETWEEN HOUSE AND POOL

By DAN TOWER

THE REINFORCED CONCRETE ROOF SLAB BETWEEN THE MAIN HOUSE AND THE SWIMMING POOL HAS, IN THE PAST, UNDERGONE SOME TRAFFIC LOADING. THE FOLLOWING ANALYSIS IS TO DETERMINE THE ALLOWABLE LOAD THAT THIS SLAB CAN CARRY.

THE SLAB IS ANALYZED FOR ONE-WAY ACTION.

SPAN = 10 ft.

f'_c = 3000 psi (ASSUMED)

f_y = 40000 psi (ASSUMED)

SLAB THICKNESS (h) = 6 INCHES

d = 4.5 INCHES (ASSUMED)

REINFORCEMENT = 5/8 INCH SQUARE @ 9 INCHES ON-CENTER (ASSUMED)

AREA OF STEEL PER FT. OF SLAB (A_s):

$$A_s = \left(\frac{5}{8}\right)^2 \left(\frac{12}{9}\right) \\ = 0.52 \text{ in}^2 / \text{ft.}$$

Determine " a " dimension

$$T = C$$

$$T = (A_s)(f_y)$$

$$C = (.85)(f'_c)(a)(b)$$

$$a = \frac{(A_s)(f_y)}{(.85)(f'_c)(b)}$$

$$= \frac{(0.52)(40)}{(.85)(3)(12)}$$

$$= 0.68 \text{ in.}$$

Determine ALLOWABLE FACTORED Moment (M_u)

$$M_u = .90(A_s)(f_y)(d - \frac{a}{2})$$

$$= .90(0.52)(40)(4.5 - \frac{0.68}{2})$$

$$= 77.9 \text{ ft-in}$$

$$= 6.5 \text{ ft-ft}$$

FORM DSC-44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 2
Area			of 2
Project	By	Checked	Pkg.
Feature	Date	Date	Account

ALLOWABLE LOADS CONT.
BY DAN TOWER

DETERMINE ALLOWABLE LIVE LOAD (L)

$$\begin{aligned}
 m_u &= \frac{U l^2}{8} \\
 &= (m_u)(8) / l^2 \\
 &= (6.5)(8) / (10)^2 \\
 &= 0.52 \text{ kips/ft} \\
 U &= 520 \text{ lb/ft} \\
 U &= 1.4D + 1.7L \\
 D &= 75 \text{ lb/ft} \\
 L &= \frac{U - 1.4D}{1.7} \\
 &= \frac{520 - 1.4(75)}{1.7} \\
 &= 244 \text{ lbs/ft of a 1ft wide section of slab} \\
 &= 244 \text{ lb/ft}^2 \text{ of surface}
 \end{aligned}$$

THE ALLOWABLE FLOOR LOAD FOR THE SLAB IS 244 psf.

FORM D S C - 44

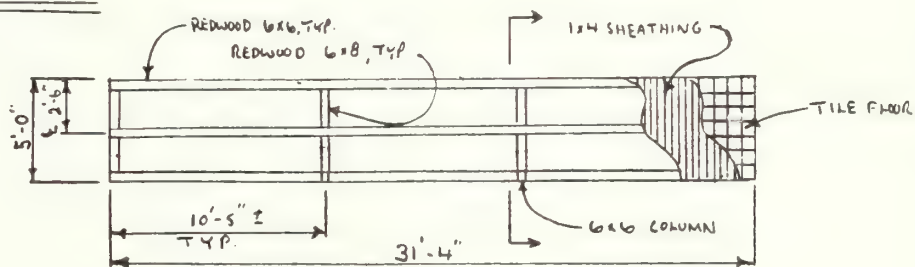
Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet	1
Area	SCOTTY'S CASTLE			of	6
Project	H.S.R.	By	DAN TOWER	Checked	
Feature	ALLOWABLE LOADS FOR GALLERIES AND BRIDGE	Date	SEPT. 1989	Date	
				Pkg.	
				Account	

ALLOWABLE LOADS FOR GALLERIES AND BRIDGE

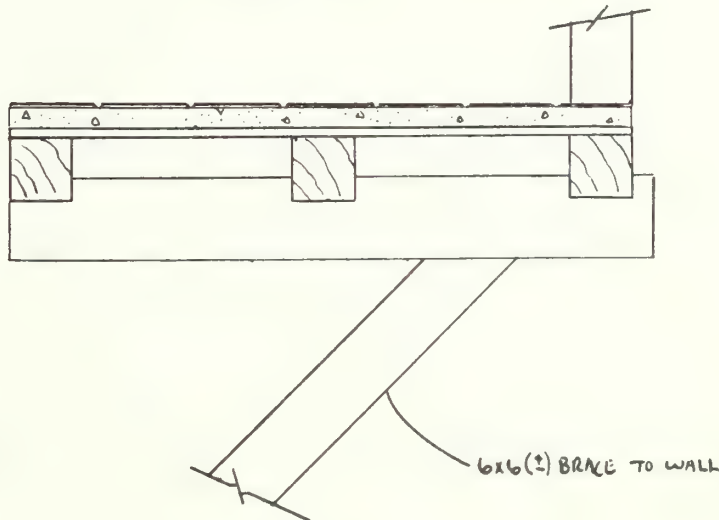
By DAN TOWER

THE MOST CRITICAL AREAS FOR DETERMINING ALLOWABLE FLOOR LOAD ARE THE NORTH AND SOUTH GALLERY'S IN THE MAIN HOUSE AND THE BRIDGE BETWEEN THE HOUSE AND THE ANNEX. THE FOLLOWING CALCULATIONS ARE TO DETERMINE THE ALLOWABLE LIVE LOADS FOR THESE TWO AREAS.

GALLERIES:



PLAN VIEW
1/8" = 1'-0"



SECTION
3/4" = 1'-0"

FORM D & C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 2
Area			of 6
Project	By	Checked	Pkg.
Feature	Date	Date	Account

GALLERIES AND BRIDGE, CONT.

By DAN TOWER

ASSUME THAT BRACES EFFECTIVELY TRANSFER ROOF AND FLOOR LOADS TO THE WALL

THE GALLERY FLOOR DEAD LOAD IS APPROXIMATELY:

Tile & Mortar = 23 psf

6 x 6 Joists = 3.2 psf

1 x 4 SHEATHING = 2.2 psf

TOTAL DL = 28.4 psf \Rightarrow SAY 30 psf.

Section Modulus (S) for 6 x 6 = $\frac{6^3}{6} = 36 \text{ in}^3$

Assume Allowable Bending Stress (F_b) = 1200 psi (NO. 2 GRADE)

$$\begin{aligned} \text{MAXIMUM ALLOWABLE MOMENT (M}_{\text{max}}) &= (F_b)(S) \\ &= (1200 \text{ lb/in}^2)(36 \text{ in}^3) \\ &= 43,200 \text{ lb-in} \\ &= 43,200 \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) \\ &= 3.6 \text{ kip-ft} \end{aligned}$$

$$\text{TRIBUTARY AREA FOR CENTER BEAM} = (1 \text{ ft})(2.5 \text{ ft}) = 2.5 \text{ ft}^2/\text{ft}$$

$$\text{DEAD LOAD} = (2.5 \text{ ft}^2/\text{ft})(30 \text{ lb/ft}^2) = 75 \text{ lb/ft}$$

Assuming beam is simply supported, THE MAXIMUM MOMENT

CAUSED BY THE DEAD LOAD (M_{DL}) = $\frac{(D.L.)(L)^2}{8}$

$$M_{DL} = \frac{(0.75 \text{ kips/ft})(10.5 \text{ ft})^2}{8}$$

$$= 1.03 \text{ kip-ft}$$

THE MAXIMUM MOMENT DUE TO A LIVE LOAD (M_{LL}) = $M_{\text{max}} - M_{DL}$

$$M_{LL} = 3.6 \text{ kip-ft} - 1.0 \text{ kip-ft} = 2.6 \text{ kip-ft}$$

ALLOWABLE LIVE LOAD ($L.L.A.L.$) = $\frac{(M_{LL})(8)}{(L)^2}$

$$L.L.A.L. = \frac{(2.6 \text{ kip-ft})(8)}{(10.5)^2} = .19 \text{ kips/ft} = 190 \text{ lbs/ft}$$

$$\text{ALLOWABLE LIVE LOAD} = \frac{190 \text{ lbs/ft}}{2.5 \text{ ft}^2/\text{ft}} = 75 \text{ lbs/ft}^2$$

FORM D & C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 3
Area			of 6
Project	By	Checked	Pkg.
Feature	Date	Date	Account

GALLERIES AND BRIDGE, CONT.	By DAN TOWER
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CHECK FOR HORIZONTAL SHEAR:

ALLOWABLE SHEAR STRESS (F_v) : 80 psiShear due to DEAD LOAD (V_{DL}) : $(D.L.)(L)/2$

$$V_{DL} = (75 \text{ lb/ft})(10.5 \text{ ft})/2$$

$$= 394 \text{ lbs} \Rightarrow \text{SAY } 400 \text{ lbs}$$

Total Allowable Shear (V_{ALL}) : $(F_v)(A)/1.5$

$$V_{ALL} = (80 \text{ lb/in}^2)(36 \text{ in}^2)/1.5$$

$$= 1920 \text{ lbs}$$

Allowable Shear due to live load $V_{LL} = V_{ALL} - V_{DL}$

$$V_{LL} = 1920 \text{ lbs} - 400 \text{ lbs} = 1520 \text{ lbs}$$

Allowable live load ($L.L._{ALL}$) : $(2)(V_{LL})/L$

$$L.L._{ALL} = (2)(1520)/10.5$$

$$= 290 \text{ lbs/ft}$$

$$\text{Allowable live load} : 290/2.5 = 116 \text{ lb/ft}^2 > 75 \text{ lb/ft}^2$$

THEREFORE 75 psf CONTROLS

CHECK FOR DEFLECTION:

MAXIMUM DEFLECTION (Δ_{max}) : $L/240$ (INCHES)

$$\Delta_{max} = (10.5 \text{ ft})(12 \text{ in/ft})/240$$

$$= 0.5 \text{ inches}$$

$$\Delta_{max} = \frac{5(L.L._{ALL})L^4}{384 EI}$$

MAXIMUM ALLOWABLE LIVE LOAD ($L.L._{ALL}$) due to deflection

$$L.L._{ALL} = \Delta_{max}(384)(E)(I)/(5)(L)^4$$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 4
Area			of 6
Project	By	Checked	Pkg.
Feature	Date	Date	Account

GALLERIES AND BRIDGE, CONT.

By DAN TOWER

where:

$$\Delta_{max} = 0.50 \text{ inches}$$

$$E = 1,250,000 \text{ PSI}$$

$$I = 108 \text{ in}^4$$

$$L = 126 \text{ in.}$$

$$L.H. ALL = \frac{(0.5 \text{ in.}) (384) (1,250,000 \text{ lb/in}^2) (108 \text{ in}^4)}{(5) (126 \text{ in})^4}$$

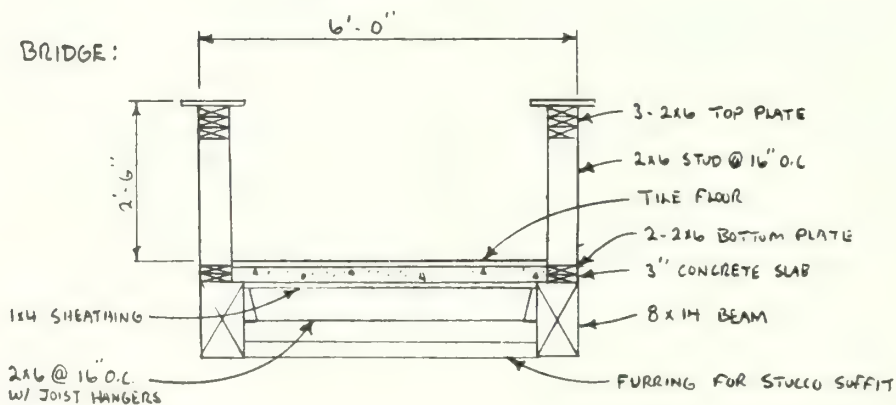
$$= 20.6 \text{ lbs/in}$$

$$= (20.6 \text{ lb/in}) (12 \text{ in/ft})$$

$$= 247 \text{ lb/ft}$$

$$\text{Allowable Live Load} = 247/2.5 = 99 \text{ psf} > 75 \text{ psf}$$

Therefore 75 psf. IS THE ALLOWABLE LIVE LOAD FOR GALLERIES



BRIDGE FRAMING SECTION

$$3/8" = 1'-0"$$

THE Bridge has a 25 ft span and the Dead load has been determined to be approximately 90 psf.

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 5
Area			of 6
Project	By	Checked	Pkg.
Feature	Date	Date	Account

GALLERIES AND BRIDGE, CONT.

By, DAN TOWER

DETERMINE THE ALLOWABLE LIVE LOAD THE BRIDGE WILL CARRY

THE UNIFORM DEAD LOAD (D.L.) CARRIED BY ONE 8x14 BEAM:

$$D.L. = (90 \text{ lb/ft}^2)(1 \text{ ft})(3 \text{ ft}) = 270 \text{ lb/ft}$$

SECTION MODULUS (S) FOR 8x14 BEAM

$$S = \frac{(8)(14)^2}{6} = 261.3 \text{ in}^3$$

ALLOWABLE BENDING STRESS (F_b) = 1300 psi (ASSUME DOUGLAS FIR, No. 1)BENDING STRESS DUE TO DEAD LOAD ($S_{b D.L.}$) = M/S MOMENT DUE TO DEAD LOAD ($M_{D.L.}$) = $(D.L.)(L)^2/8$

$$M_{D.L.} = \frac{(270 \text{ lb/ft})(25 \text{ ft})^2}{8}$$

$$= 21,094 \text{ lb-ft}$$

$$S_{b D.L.} = \frac{M}{S}$$

$$= \frac{(21,094 \text{ lb-ft})(12 \text{ in/ft})}{261.3 \text{ in}^3}$$

$$= 969 \text{ psi}$$

ALLOWABLE bending stress due to live load ($S_{b L.L.}$) = $F_b - S_{b D.L.}$

$$S_{b L.L.} = 1300 \text{ psi} - 969 \text{ psi} = 331 \text{ psi}$$

ALLOWABLE Moment due to live load ($M_{L.L.}$) = ($S_{b L.L.}$)(S)

$$M_{L.L.} = (331 \text{ psi})(261.3 \text{ in}^3) = 86,490 \text{ lb-in}$$

$$= 7,208 \text{ lb-ft}$$

ALLOWABLE Live Load in lbs/ft (L.L.) = ($M_{L.L.}$)(8)/ L^2

$$L.L. = \frac{(7208 \text{ lb-ft})(8)}{(25 \text{ ft})^2}$$

$$= 92 \text{ lbs/ft}$$

With a tributary Area of 3 ft² per foot of beamALLOWABLE live load (L.L.all.) = (L.L.)/(3 ft²)

$$L.L.all. = 92/3 \approx \underline{31 \text{ psf}}$$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 6
Area			of 6
Project	By	Checked	Pkg.
Feature	Date	Date	Account

GALLERIES AND BRIDGE, CONT.	By DAN TOWER
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CHECK FOR SHEAR UNDER MAXIMUM LOADING :

D.L. = 90 psf
 L.L. = 30 psf
 Maximum Load = 120 psf
 Maximum SHEAR (V_{max}) = $(120 \text{ lb/ft}^2)(25\text{ft})(3\text{ft}) / 2$
 $V_{max} = 4500 \text{ lbs}$
 Maximum Shear Stress (S_v) = $1.5 V_{max} / A$
 $S_v = \frac{(1.5)(4500)}{(8)(14)}$
 $= 60 \text{ psi}$
 Maximum Allowable Shear Stress (F_v) = 85 psi
 Since $S_v < F_v$, BRIDGE BEAMS ARE O.K. FOR SHEAR.

CHECK FOR DEFLECTION UNDER MAXIMUM LOADING:

Maximum Allowable DEFLECTION (Δ_{max}) = $L / 240$ INCHES
 $\Delta_{max} = (25)(12) / 240$
 $\Delta_{max} = 1.25$ INCHES
 Actual DEFLECTION (Δ) = $\frac{5 w l^4}{384 EI}$
 WHERE:
 $w = 90 \text{ lb/ft}$
 $= 7.5 \text{ lb/in.}$
 $l = 300 \text{ in.}$
 $E = 1,200,000 \text{ lbs/in}^2$
 $I = 1829.3 \text{ in}^4$
 $\Delta = \frac{(5)(7.5)(300)^4}{384 (1,200,000)(1829.3)}$
 $= 0.36$ INCHES
 Since $\Delta < \Delta_{max}$, BRIDGE BEAMS ARE O.K. FOR DEFLECTION

FORM D & C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area SCOTTY'S CASTLE			of
Project HSR	By R. SILVA	Checked	Pkg. 357
Feature BRIDGE LOAD	Date 11/22/89	Date	Account

DEVA
SCOTTY'S CASTLE
HSR
BRIDGE LOAD

BY: R. SILVA

PKG. 357

11/22/89

UNKNOWN:

- ① TYPE AND CONDITION OF CONNECTION BETWEEN BRIDGE STRUCTURAL MEMBERS AND BUILDINGS
CONSTRUCTION DRAWINGS ARE UNCLEAR AND EXAMINATION WITH BORESCOPE WAS INCONCLUSIVE
- ② CONDITION OF WOOD STRUCTURAL MEMBERS THROUGHOUT THE STRUCTURE
WHAT COULD BE SEEN WITH THE BORESCOPE IS IN GOOD CONDITION
- ③ EXACT WOOD SPECIES OF STRUCTURAL MEMBERS
BASED ON CONSTRUCTION RECORDS THE SPECIES IS PROBABLY DOUGLAS-FIR
- ④ EXACT DEAD LOAD WEIGHT OF MATERIALS ON BRIDGE
THE DEAD LOAD WAS BASED ON THE CONSTRUCTION DRAWINGS AND VISUAL EXAMINATION

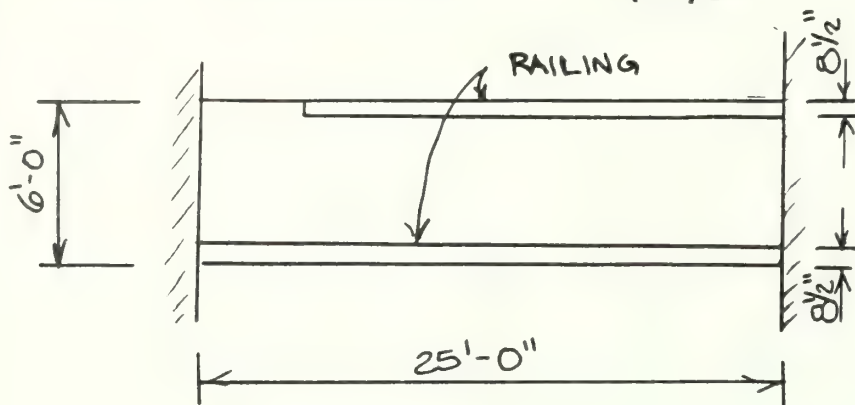
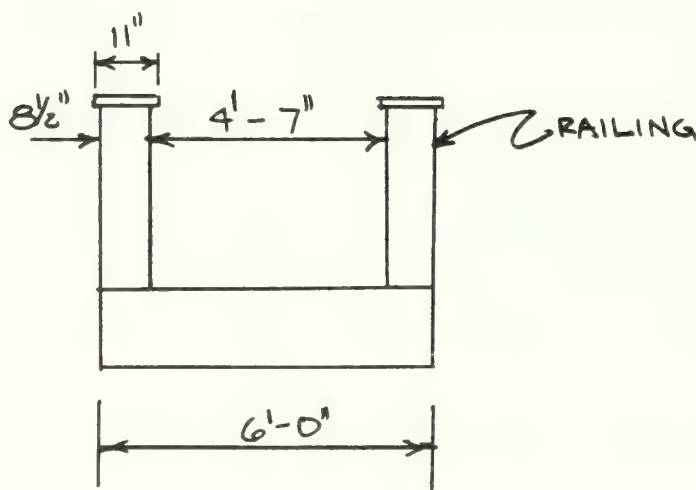
DUE TO THE NUMBER OF UNKNOWN AND ASSUMPTIONS, THE ALLOWABLE LIVE LOAD WILL BE REDUCED 20%

$$LL_{ALL} = 31 (1 - 0.20) = \underline{25 \text{ psf}}$$

↑
LL_{ALL} = 31 psf FROM PREVIOUS CALCULATIONS

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project	By R SILVA	Checked	Pkg.
Feature	Date 11/22/89	Date	Account

BRIDGE DIMENSIONSR SILVA
11/22/89PLAN
NO SCALESECTION
NO SCALE

$$\begin{aligned} \text{AVAILABLE AREA} &= 4'-7'' \text{ BY } 25'-0'' \\ &= 114.5 \text{ ft}^2 \end{aligned}$$

FORM DSC-44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project	By R SILVA	Checked	Pkg.
Feature	Date 11/22/89	Date	Account

R. SILVA 11/22/89
TOTAL WT. ALLOWED ON THE BRIDGE,
BASED ON UNIFORM LOADING:

$$\begin{aligned}
 \text{CAPACITY} &= \text{AVAILABLE AREA} \times \text{LLAIL} \\
 &= 114.5 \text{ ft}^2 \times 25^{\#} / \text{ft}^2 \\
 &= \underline{\underline{2863^{\#}}}
 \end{aligned}$$

MAXIMUM NUMBER OF PEOPLE ALLOWED
ON THE BRIDGE:

$$\begin{aligned}
 \# \text{ OF PEOPLE} &= \text{CAPACITY} \div \begin{matrix} * \\ \text{AVERAGE WT.} \\ \text{OF A PERSON} \end{matrix} \\
 &= 2863^{\#} \div 150^{\#} \\
 &= \underline{\underline{19}}
 \end{aligned}$$

* 150[#] IS USED BY THE ELEVATOR INDUSTRY TO
DETERMINE MAX. NUMBER OF PASSENGERS

* U.S. GPO: 1984-776-378

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project	By R. SILVA	Checked	Pkg.
Feature	Date 11/22/89	Date	Account

R. SILVA 11/22/89
THE ALLOWABLE LIVE LOAD BENDING STRESS
FROM PREVIOUS CALCULATIONS $f_b = 331 \text{ psi}$

$$M_{\max} = \frac{Pl}{4}$$

$$l = 25 \text{ ft}$$

$$S = 261.3 \text{ in}^3$$

8x14

$$M = f_b \cdot S = 331 \text{ #/in}^2 \times 261.3 \text{ in}^3$$

$$= 86,490.3 \text{ #-in}$$

$$P = \frac{4(86,490.3)}{25 \times 12 \text{ in}} = 1153.2 \text{ #}$$

DUE TO THE NUMBER OF UNKNOWN AND ASSUMPTIONS, THE ALLOWABLE CONCENTRATED LOAD WILL BE REDUCED 20%

$$P_{\text{ALL}} = 1153.2 (1 - 0.20) = \underline{\underline{923 \text{ #}}}$$

ALLOWABLE CONCENTRATED LOAD PLACED
UPON ANY SPACE $2\frac{1}{2} \text{ ft}^2$ SQUARE.

H34 (DSC-TWE)
DEVA-357-35

DEC 20 1989

Memorandum

To: Regional Director, Western Region

From: Manager, Western Team, Denver Service Center

Reference: Death Valley National Monument (DEVA), Pkg. 357,
Scotty's Castle, Preserve Main House and Annex,
Historic Structural Report (HSR), PT: 35

Subject: Structural Loading Capacity of Bridge

This memorandum is in response to the request during the November 13-16, 1989, field trip from the Superintendent, Death Valley National Monument, for the subject load capacity to assist in discussions concerning future tour agreements, staffing, and operations.

Based on the data available to date, the bridge should be rated for a safe live load capacity of 25 pounds per square foot uniform loading, or a 923 pound concentrated load placed upon any space 2-1/2 feet square, or a maximum of 19 people.

These loading limits will be included in the Historic Structure Report (HSR), along with the calculations. The HSR will also address other related considerations, such as tour group size in relation to artifact protection and building wear.

If you have any questions, please contact Richard Silva at 303-969-2552 or FTS 327-2552.

/s/ Caleb G. Cooper

Caleb G. Cooper

cc:
Supt., Death Valley NM

Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet	1
Area	SCOTTY'S CASTLE			of	2
Project	H.S.R.	By	DAN TOWER	Checked	
Feature	VERANDA ROOF WIND LOADS	Date	SEPT. 1989	Date	
				Pkg.	
				Account	

VERANDA ROOF WIND LOADS

By DAN TOWER

THE VERANDA ROOF IS SUPPORTED BY PIPE WHICH IS CONNECTED TO FLAT 2x6 JOISTS. MANY OF THE CLAMPS WHICH CONNECT THE PIPE TO THE JOIST HAVE COME LOOSE. THIS ANALYSIS IS TO CHECK FOR THE EFFECTS OF WIND ON THE CONNECTIONS.

FROM THE UNIFORM BUILDING CODE, 1988 EDITION
CHAPTER 23, SECTION 2311:

$$\text{WIND PRESSURE (p)} = C_e C_q q_s I$$

WHERE:

 $C_e = 0.7$ (FOR EXPOSURE B)

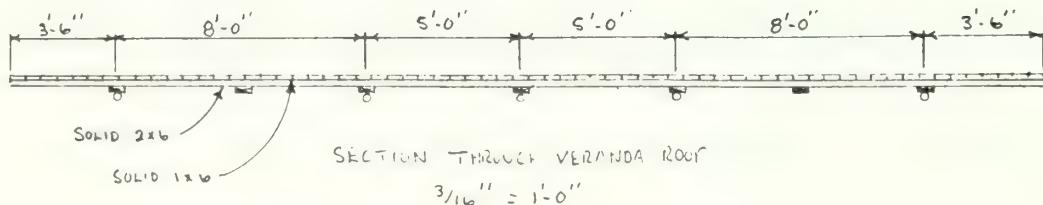
 $C_q = 1.6$ (OUTWARD)

 $q_s = 21$ (FOR AN ASSUMED WIND SPEED OF 90 MPH)

 $I = 1.0$

$$p = (0.7)(1.6)(21)(1.0)$$

$$= 23.5 \text{ psf}$$



DETERMINE ROOF DEAD LOAD:

$$2 \times 6 = 2.0 \text{ plf} \Rightarrow 4.0 \text{ psf}$$

$$1 \times 6 = 1.0 \text{ plf} \Rightarrow 2.0 \text{ psf}$$

$$\text{MISC.} = 1.5 \text{ psf} \Rightarrow 1.5 \text{ psf}$$

$$\text{TOTAL} \quad \underline{\quad\quad\quad} \quad 7.5 \text{ psf}$$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 2
Area			of 2
Project	By	Checked	Pkg.
Feature	Date	Date	Account

VERANDA Roof, CONT.	by Dan Tower
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DETERMINE MAXIMUM LOAD ON A CLAMP CONNECTION

Tributary AREA = $(7.5 \text{ FT})(6 \text{ FT}) = 45 \text{ FT}^2$ (assumes 2 clamps per joist)

UPWARD LOAD : $(45 \text{ FT}^2)(23.5 \text{ lb/ft}^2 - 7.5 \text{ lb/ft}^2) = 720 \text{ lbs}$

• U.S. GPO: 1984-778-378

Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet	1
Area	SCOTTY'S CASTLE			of	1
Project	H.S.R.	By	DAN TOWEL	Checked	
Feature	MEMBER STRESS UNDER PRESENT DEAD LOAD FOR MAIN HOUSE LOWER ROOFS	Date	SEPT. 1989	Date	
	MEMBER STRESS UNDER PRESENT DEAD LOAD - MAIN HOUSE ROOFS	by	Dan Towel	Pkg.	
				Account	

THERE IS CONCERN THAT THE ROOF SYSTEMS FOR SCOTTY'S CASTLE MAY BE INADEQUATE FOR THE LOADS THEY ARE CARRYING. BECAUSE THE LIVING HALL TRUSSES HAVE ALREADY BEEN ANALYZED AND REINFORCED TO CARRY THEIR LOADS, THE NEXT MOST CRITICAL ROOF SYSTEMS ARE THE TWO LOWER ROOFS OF THE MAIN HOUSE. THESE TRUSSES ARE ANALYZED BELOW.

DESCRIPTION:

THE LOWER ROOF CONSISTS OF 2x8 RAFTERS AT 16" ON CENTER WITH A 15 FT SPAN AND WITH A 3:12 SLOPE. EVERY OTHER RAFTER IS BRACED IN THE MIDDLE.

LOAD:

2 INCH MORTAR BED	=	3/12 (150) = 25 psf
TILE	=	10 psf
SHEATHING	=	2 psf
FRAMING	=	3 psf
TOTAL DEAD LOAD	=	40 psf

@ 16" O.C., LOAD = (40)(17/12) = 53 plf PER RAFTER

MOMENT (due to dead load):

$$M = \frac{wL^2}{8}$$

$$= \frac{53(15)^2}{8}$$

$$= 1500 \text{ lb-ft}$$

MEMBER STRESS:

$$\sigma = \frac{M}{S}$$

$$S = 13.14 \text{ in}^3$$

$$= \frac{(1500 \text{ lb-ft})(12 \text{ in/ft})}{13.14 \text{ in}^3}$$

$$= 1370 \text{ psi} < 1750 \text{ psi} \Rightarrow \text{O.K. FOR DEAD LOAD}$$

ALLOWABLE STRESS

$F_s = 1750 \text{ psi}$
(ASSUMES DOUGLAS FIR
No. 1 GRADE)

APPENDIX B, PEAK GROUND MOTION DATA FROM NUCLEAR TESTING AND EARTHQUAKES RECORDED AT SCOTTY'S CASTLE BY DOE

URS**URS/JOHN A. BLUME & ASSOCIATES, ENGINEERS**3060 SOUTH HIGHLAND DRIVE
LAS VEGAS, NEVADA 89109
TEL: (702) 295-1650

OFFICES

October 4, 1989

ccf 10/6/89
Mr. C. Craig Frazier
U.S. National Park Service
Denver Service Center
12795 W. Alameda Pkwy.
P.O. Box 25287
Denver, CO 80225

Dear Mr. Frazier:

Enclosed is the tabulated peak ground motion values from underground nuclear tests at the Nevada Test Site and earthquakes that were recorded at Scotty's Castle from 1982 to date.

As you can see, the listings are composed of date of detonation, test name, location, acceleration and velocity values from each component and a USGS assigned magnitude. The USGS magnitude is included for a comparative size relationship. The location parameter is a general indicator to where the test was conducted, PM for Pahute Mesa and YF for Yucca Flat.

Please note that the velocity values are continuous from 1982 to present. We did not have an acceleration instrument at the castle until 1986. Missing data indicates no measurements were recorded due to instrument failures or malfunctions.

If you have any questions regarding the data, please feel free to call Walt Jungblut or me at FTS 575-1650. Thank you for your patience and cooperation in this matter.

Sincerely,

Joseph L. Woodruff
Joseph L Woodruff
Manager, Las Vegas Office

Attachment



AN INTERNATIONAL PROFESSIONAL SERVICES ORGANIZATION

PEAK GROUND MOTION RECORDED AT SCOTTY'S CASTLE
(NTS EVENTS)
1982 THROUGH 1989

DATE	EVENT	LOCATION	VERTICAL		NORTH		WEST		USGS MAG (Mb)
			ACC (g)	VEL (cm/sec)	ACC (g)	VEL (cm/sec)	ACC (g)	VEL (cm/sec)	
06/24/82	NEBBIOLO	PM		0.382		0.220		0.342	5.6
07/29/82	MONTEREY	YF		0.027		0.054		0.044	4.5
03/26/83	CABRA	YF		0.078		0.084		0.146	5.1
04/14/83	TURQUOISE	YF		0.266		0.133		0.183	5.3
12/16/83	ROMANO	YF		0.053		0.090		0.042	5.1
03/01/84	TORTUGAS	YF		0.276		0.235		0.207	5.9
05/01/84	MUNDO	YF		0.173		0.172		0.135	5.3
05/31/84	CAPROCK	YF		0.204		0.232		0.142	5.7
06/20/84	DUORO	YF		0.017		0.024		0.020	4.8
07/25/84	KAPPELI	PM		0.100		0.098		0.092	5.4
12/09/84	EGMONT	PM		0.096		0.111		0.108	5.5
12/15/84	TIERRA	PM		0.183		0.136		0.035	5.4
03/15/85	VAUGHN	YF		0.031		0.038		0.035	4.8
03/23/85	COTTAGE	YF		0.252		0.194		0.127	5.4
04/02/85	HERMOSA	YF		0.238		0.234		0.171	5.7
05/02/85	TOWANDA	PM		0.102		0.139		0.130	5.7
06/12/85	SALUT	PM		0.284		0.232		0.287	5.5
07/25/85	SERENA	PM		0.187		0.206		0.134	5.2
10/16/85	ROQUEFORT	YF		0.010		0.046		0.024	4.6
12/05/85	KINIBITO	YF		0.207		0.180		0.173	5.7
12/28/85	GOLDSTONE	PM		0.108		0.148		0.131	5.3
03/22/86	GLENCOE	YF	0.0027	0.093	0.0023	0.185	0.0020	0.129	5.2
04/22/86	JEFFERSON	PM	0.0125	0.261	0.0087	0.241	0.0064	0.052	5.3
06/05/86	TAJO	YF		0.150		0.135		0.110	5.3
06/25/86	DARWIN	PM	0.0044	0.124	0.0034	0.164	0.0025	0.129	5.5
07/17/86	CYBAR	PM	0.0069	0.306	0.0057	0.133	0.0037	0.154	5.7
09/30/86	LABQUARK	PM	0.0033	0.139	0.0021	0.158	0.0022	0.181	5.5
10/16/86	BELMONT	PM	0.0072	0.150	0.0036	0.148	0.0055	0.193	5.6
11/14/86	GASCON	YF	0.0067	0.288	0.0062	0.254	0.0056	0.203	5.8
12/13/86	BODIE	PM	0.0044	0.103	0.0031	0.103	0.0023	0.101	5.5
04/18/87	DELAMAR	PM	0.0025	0.065	0.0023	0.185	0.0025	0.128	5.5
04/30/87	HARDIN	PM	0.0062	0.109	0.0033	0.146	0.0041	0.138	5.5
07/16/87	MIDLAND	YF	0.0013	0.048	0.0010	0.050	0.0001	0.050	4.8
08/13/87	TAHOKA	YF	0.0041	0.268	0.0051	0.263	0.0045	0.254	5.9
09/24/87	LOCKNEY	PM	0.0106	0.246	0.0059	0.254	0.0050	0.175	5.7
10/23/87	BORATE	YF	0.0019	0.050	0.0008	0.070	0.0007	0.052	5.2
02/16/88	KERNVILLE	PM	0.0017	0.061	0.0011	0.099	0.0014	0.109	5.3
05/13/88	SCHELLBOURNE	YF		0.019		0.040		0.025	4.8
06/02/88	COMSTOCK	PM	0.0149	0.679	0.0106	0.308	0.0085	0.309	5.4
07/07/88	ALAMO	PM	0.0156	0.365	0.0100	0.338	0.0076	0.285	5.6
08/17/88	KEARSARGE	PM	0.0033	0.168	0.0028	0.133	0.0024	0.141	5.5
08/30/88	BULLFROG	YF	0.0014	0.056	0.0010	0.086	0.0010	0.050	5.0
10/13/88	DALHART	YF	0.0081	0.417	0.0068	0.289	0.0051	0.273	5.9
02/10/89	TEXARKANA	YF	0.0015	0.068	0.0016	0.070	0.0014	0.049	5.2
03/09/89	INGOT	YF	0.0010	0.053	0.0010	0.067	0.0008	0.039	4.9
06/22/89	CONTACT	PM	0.0073		0.0037		0.0028		5.2
06/27/89	AMARILLO	PM	0.0016	0.098	0.0016	0.089	0.0011	0.067	4.9



AN INTERNATIONAL PROFESSIONAL SERVICES ORGANIZATION

PEAK GROUND MOTION RECORDED AT SCOTTY'S CASTLE
(EARTHQUAKES)
1982 THROUGH 1986

DATE	LOCATION	USGS			
		VERTICAL (cm/sec)	NORTH (cm/sec)	WEST (cm/sec)	MAG (Mb)
10/08/82	Ridgecrest, CA	0.138	0.147	0.331	4.9
01/06/83	Mammoth Lakes, CA	0.068	0.103	0.174	5.1
01/06/83	Mammoth Lakes, CA	0.061	0.102	0.155	5.1
05/02/83	Coalinga, CA	0.060	0.035	0.073	6.5
07/03/83	Mammoth Lakes, CA	0.212	0.396	0.527	4.2
09/09/83	Coalinga, CA	0.027	0.063	0.055	5.2
09/30/83	Mammoth Lakes, CA	0.004	0.011	0.017	4.5
10/28/83	Mackay, ID	0.088	0.155	0.127	6.2
11/23/84	Mammoth Lakes, CA	0.123	0.269	0.254	5.6
11/26/84	Mammoth Lakes, CA	0.030	0.074	0.058	5.2
08/04/85	Coalinga, CA	0.004	0.008	0.005	5.4
01/26/86	Central California	0.040	0.117	0.079	5.1
03/06/86	Gold Mtn, CA/NV	0.232	0.371	0.631	3.7
06/04/86	Gold Mtn, CA/NV	0.123	0.174	0.133	4.0
07/13/86	Oceanside, CA	0.023	0.031	0.024	5.3
07/20/86	Bishop, CA	0.173	0.511	0.385	5.5
07/21/86	Chalfant Valley, CA	0.399	0.791	0.716	6.0
07/21/86	Bishop, CA	0.055	0.108	0.091	5.3
07/31/86	Bishop, CA	0.230	0.452	0.633	5.9
08/01/86	Bishop, CA	0.054	0.093	0.100	4.9
09/24/86	Gold Mtn, CA/NV	0.042	0.072	0.039	3.5
09/24/86	Gold Mtn, CA/NV	0.066	0.093	0.100	3.7

URS

AN INTERNATIONAL PROFESSIONAL SERVICES CORPORATION

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SAN FRANCISCO
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July 26, 1982

Mr. Jack Fields
Unit Manager
Scotty's Castle
Death Valley National Monument
Death Valley, California 92328

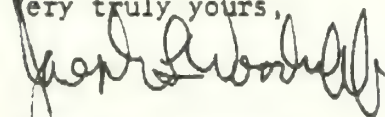
SUBJECT: Motion Measurements at Scotty's Castle

Dear Mr. Fields:

On behalf of DOE/NV, we would like to thank you and your staff for the cooperation provided us over the years in our effort to record and measure seismic motion at Scotty's Castle. For your information we have enclosed a tabulation of peak motion that we have recorded thus far that may be of interest to both you and Mr. Maurice Paul at the Denver office. We will be performing further processing of these records, and once complete we will be providing you with additional information.

Again, we wish to express our appreciation for your cooperation and to respectfully request your continued support.

Very truly yours,

Joseph L. Woodruff
Manager
Las Vegas Office

alg

cc: Richard Navarro, DOE/NV

bcc: KKH, DRS, BRB, DLW, DEC, CHRON (2)

Cohen
CHRON


PEAK MOTION RECORDING AT SCOTTY'S CASTLE
BASEMENT OF LIVING HALL

<u>DATE</u>	<u>USGS MAG</u>	<u>VERT</u>	<u>VELOCITY MEASUREMENTS (cm/sec)</u>	
			<u>T(N/S)</u>	<u>L(E/W)</u>
6/28/79	?	0.06	0.05	0.05
9/06/79	5.5	0.48	0.35	0.32
9/26/79	5.4	0.20	0.14	0.16
4/16/80	5.5	0.13	0.12	0.12
4/28/80	5.4	0.24	0.18	0.13
5/31/80*	4.6	0.01	0.02	0.02
6/12/80	5.6	0.12	0.09	0.07
7/25/80	5.7	0.21	0.24	0.18
12/17/80	5.1	0.03	0.04	0.05
1/15/81	5.6	0.20	0.11	0.25

<u>DATE</u>	<u>VERT</u>	<u>ACCELERATION MEASUREMENTS (g)</u>	
		<u>T(N/S)</u>	<u>L(E/W)</u>
9/30/81* 4.2	0.0036	0.0047	0.0086
12/03/81 4.7	0.0007	0.0004	0.0003

* Denotes earthquake motion. Earthquakes of 5/25/80 and 5/27/80 were not recorded at the site.

PEAK MOTION RECORDING AT SCOTTY'S CASTLE
LIVING HALL TRUSS

<u>DATE</u>	<u>VELOCITY MEASUREMENTS (cm/sec)</u>					
	<u>TRUSS</u>		<u>BALCONY</u>		<u>GROUND</u>	
	<u>VERT</u>	<u>N/S</u>	<u>VERT</u>	<u>N/S</u>	<u>VERT</u>	<u>N/S</u>
9/25/80 3.7	0.09	0.03	0.02	0.02	0.02	0.02
12/17/80 5.1	0.13	0.10	0.04	0.08	0.03	0.03
1/15/81 5.6	1.08	0.25	0.51	0.26	0.27	0.22
6/6/81 5.6	0.58	0.34	0.19	0.21	0.11	0.27

APPENDIX C, SEISMIC CALCULATIONS

FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project HSR	By R SILVA	Checked	Pkg.
Feature MAIN BUILDING WEIGHTS	Date	Date	Account

BUILDING WEIGHTS, MAIN HOUSE

ROOF:

86,480
68,260
8,262
2,400
2,060
<hr/>
167,462 #

2ND FLOOR

16,154
13,870
19,774
15,007
13,061
44,880
12,825
<hr/>
135,571 #

40 % EXT. WALLS

$135,571 \# + 135,702 \# = 271,273 \#$

1ST FLOOR

417,453
6,696
<hr/>
424,149 #

60% EXT. WALLS

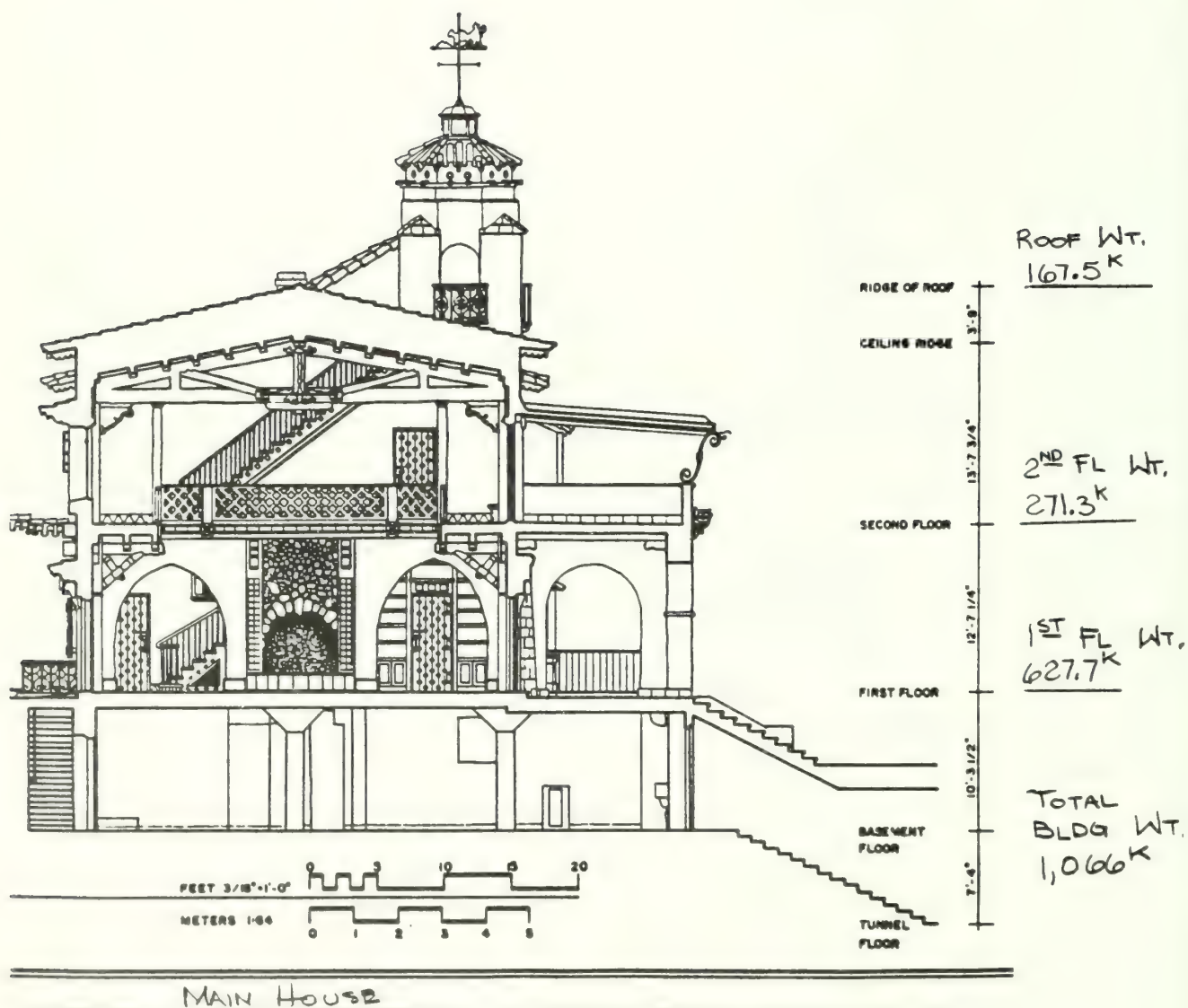
$424,149 \# + 203,553 \# = 627,702 \#$

EXT. WALLS

45,646
120,417
65,796
<hr/>
107,446
<hr/>
339,255 #

TOTAL WT. = 1,066 K

MAIN HOUSE



FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project HSR	By R SILVA	Checked	Pkg.
Feature MAIN HOUSE	Date	Date	Account

BASE SHEAR UBC 1988 CODE MAIN HOUSE

$$V = \frac{ZIC}{R_w} W$$

$$Z = 0.40 \text{ (ZONE 4)}$$

$$I = 1.0 \text{ STANDARD OCCUPANCY}$$

$$S_2 = 1.2 \text{ SOIL TYPE 2 STIFF SOIL CONDITIONS}$$

$$R_w = 8 \text{ BEARING WALL SYSTEM / FRAMED SHEAR WALLS}$$

$$T = 0.02 h^{3/4}$$

$$h = 26 \text{ ft} \quad T = 0.02 (26)^{3/4} = 0.23$$

$$C = \frac{1.25 S}{T^{2/3}} = \frac{1.25 (1.2)}{(0.23)^{2/3}} = 4 > 2.75$$

$$\frac{C}{R_w} = \frac{2.75}{8} = 0.34 > 0.075$$

$$W = 1066 \text{ K}$$

$$V = \frac{0.40 (1) (2.75) (1066)}{8} = 146.6 \text{ K}$$

$$T < 0.7 \quad F_t = 0 \quad F_x = \frac{V w_x h_x}{\sum w_i h_i} \quad M_x = \sum F_i (h_i - h_x)$$

LEVEL	h, ft	w_x, K	$w_x h_x$	F_x, K	V_x, K	$M_x, \text{K-ft}$
ROOF	26	167.5	4355	81	81	1053
2 ND	13	271.3	3527	65.6	146.6	2959
1 ST	0	627.7	7882	146.6		
		1,066				

MAIN HOUSE SEISMIC FORCES

OVERTURNING

$$M_{SEISMIC} = 2959^{K-ft}_{BLDG}$$

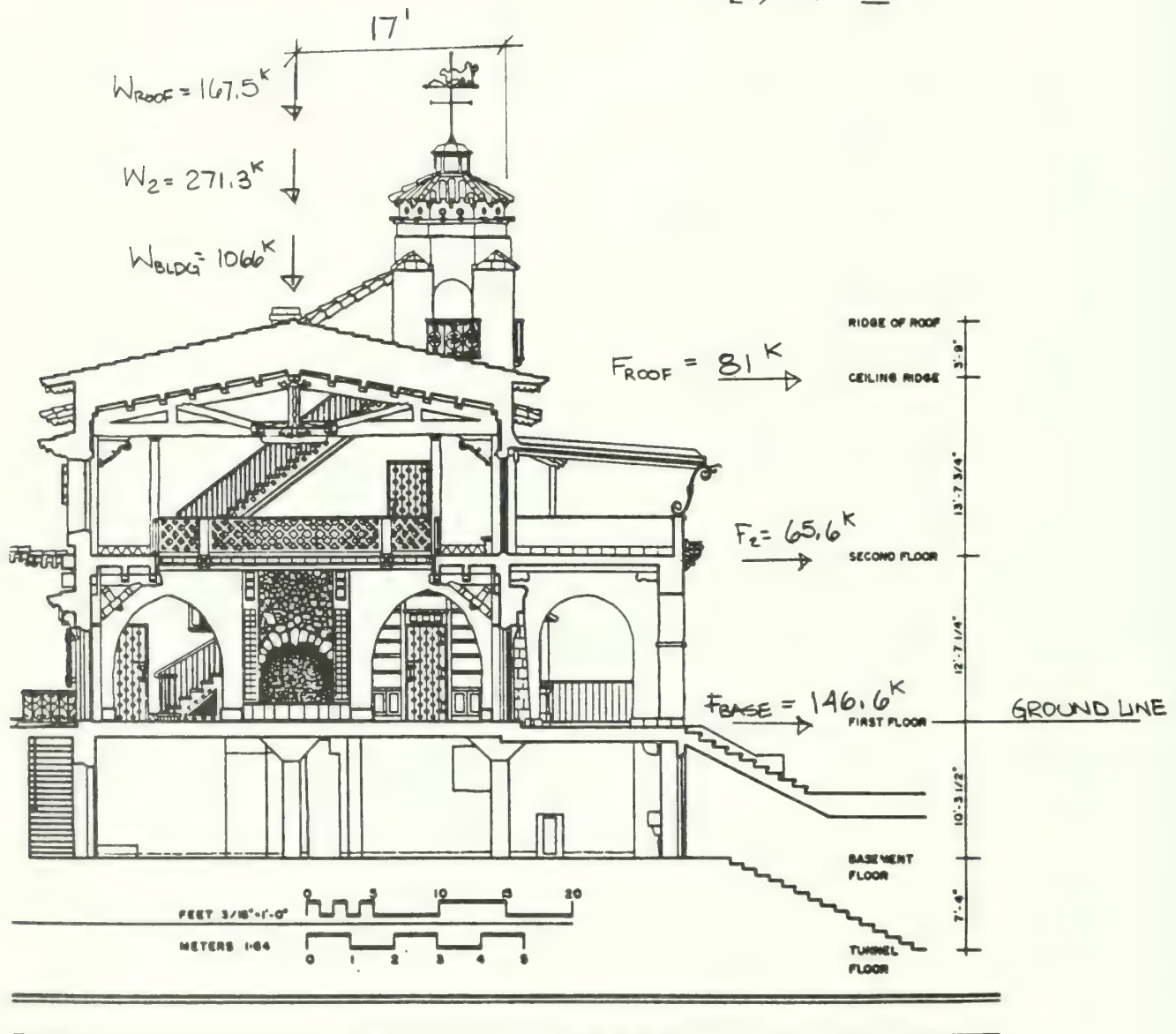
$$M_{RESIST.} = 1066^{K} \times \frac{2}{3} \times 17' = 12081^{K-ft}$$

$$M_R > M_S \quad \underline{OK}$$

$$M_{SEISMIC} = 1053^{K-ft}_{ROOF}$$

$$M_{RESIST.} = 167.5^{K} \times \frac{2}{3} \times 17' = 1898^{K-ft}$$

$$M_R > M_S \quad \underline{OK}$$



FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project HSR	By R SILVA	Checked	Pkg.
Feature MAIN HOUSE	Date	Date	Account

DIAPHRAGM SHEARS, MAIN HOUSE

USING THE TOTAL FORCE TRIBUTARY TO THE DIAPHRAGM AT THAT LEVEL.
CONSERVATIVE APPROACH
SINCE THE FORCE AT THAT LEVEL CAN BE REDUCED BY THE RATIO OF MASS THAT GENERATES SEISMIC FORCES AT THAT LEVEL TO TOTAL MASS AT THAT LEVEL,

$$F'_i = \frac{W'_i}{W_i} F_i$$

$$F_R = 81^k \quad L_2 = 97.5 \text{ Ft}$$

$$V_R = \frac{F_R}{L_R} \quad V_R = \frac{81^k}{97.5} = 831 \text{ pif @ ROOF}$$

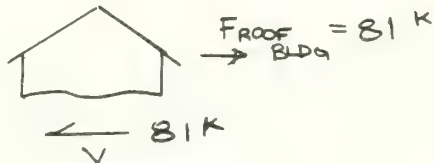
$$F_2 = 65.6^k \quad L_2 = 121$$

$$V_2 = \frac{65.6^k}{121 \text{ Ft}} = 542 \text{ pif @ SECOND FLOOR}$$

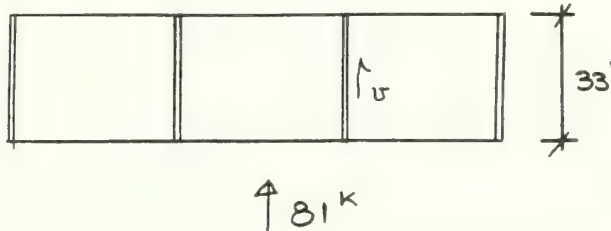
• U.S. GPO: 1984-778-378

FORM D S C - 44

Park <u>DEVA</u>	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project <u>HSR</u>	By <u>R SILVA</u>	Checked	Pkg.
Feature <u>MAIN HOUSE</u>	Date	Date	Account

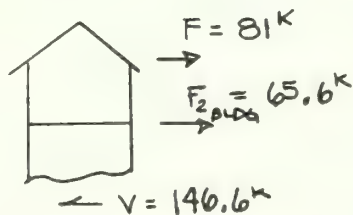
WALL SHEARS, MAIN HOUSE2ND FLOOR

USING 4 WALLS 33 FE IN LENGTH



$$V_{\text{wall}} = \frac{81}{4} = 20.25 \text{ K}$$

$$v = \frac{20.25}{33} = 614 \text{ p/f}$$

1ST FLOOR

USING 5 WALLS - 33 FE

$$V = \frac{146.6}{5} = 29.3 \text{ K}$$

$$v = \frac{29.3}{33} = 888.5 \text{ p/f}$$

FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area SCOTTY'S CASTLE			of
Project HSR	By R SILVA	Checked	Pkg.
Feature ANNEX BLDG WEIGHTS	Date 7/16/90	Date	Account

ANNEX BUILDING WEIGHTS

ROOF
 $DL = 35 \text{ psf}$
 $LL = 20 \text{ psf}$
 $55 \text{ psf} \times 120.5 \text{ ft} \times 31.5 \text{ ft} = 208.8^{\text{K}}$

2ND FLOOR WALLS
 $DL = 44.3 \text{ psf} \times 10 \text{ ft} \times [2(120.5) + 2(31.5)] = 135.3^{\text{K}}$

2ND FLOOR
 $DL = 35.8 \text{ psf}$
 $LL = 40 \text{ psf}$
 $75.8 \text{ psf} \times 120.5 \times 31.5 = 287.7^{\text{K}}$

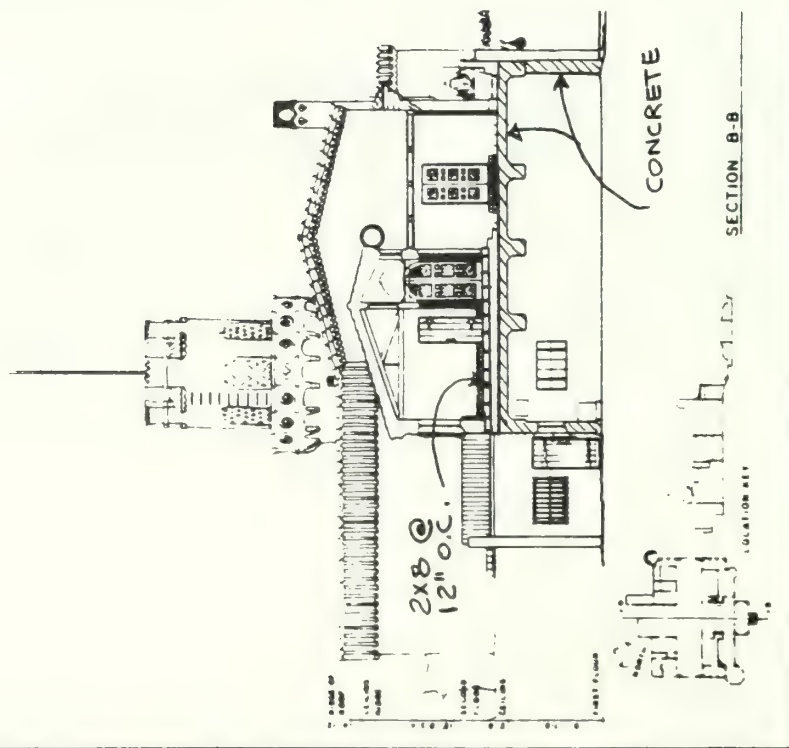
1ST FLOOR WALLS
 $150 \text{ \#/ft}^3 \times 1 \text{ ft} \times 10 \text{ ft} \times [2(120.5) + 2(31.5)] = 456^{\text{K}}$

2ND FLOOR SUBFLOOR (CONCRETE SLAB)
 $150 \text{ \#/ft}^3 \times 0.75 \times 120.5 \times 31.5 = 427^{\text{K}}$

TOTAL BLDG WT. = 1514.8^K

* U.S. GPO: 1984-778-378

ANNEX BUILDING WEIGHTS



ROOF WT. 208.8^K

2ND WT 850^K
 $208.8 + 135.3 + 287.7 + 427 = 1058.8^K$

1ST FLOOR 456^K
 $1058.8 + 456 = 1514.8^K$
 TOTAL BLDG WT.

FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project HSR	By R SILVA	Checked	Pkg.
Feature ANNEX	Date	Date	Account

BASE SHEAR UBC 1988 CODE ANNEX

$$V = \frac{ZIC}{R_w} W$$

$$Z = 0.40 \quad (\text{ZONE 4})$$

$$I = 1 \quad \text{STANDARD OCCUPANCY}$$

$$S_2 = 1.2 \quad \text{SOIL TYPE 2 STIFF SOIL CONDITIONS}$$

$$R_w = 6 \quad \text{BEARING WALL SYSTEM / CONC. SHEAR WALLS}$$

$$T = 0.02 h^{3/4}$$

$$h = 20 \text{ ft} \quad T = 0.02(20)^{3/4} = 0.19 \text{ SEC}$$

$$C = \frac{1.25 S}{T^{2/3}} = \frac{1.25(1.2)}{(0.19)^{2/3}} = 4.54 > 2.75$$

$$\frac{C}{R_w} = \frac{2.75}{6} = 0.46 > 0.075$$

$$W = 1514.8 \text{ K}$$

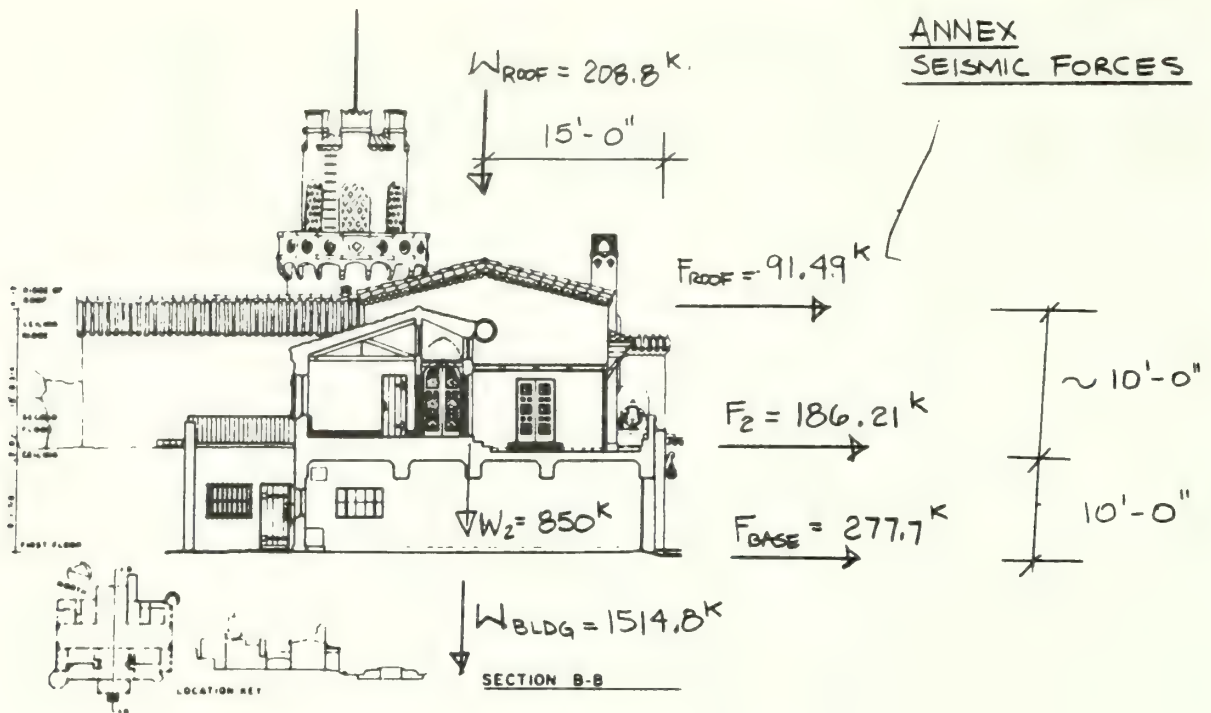
$$V = \frac{0.40(1)(2.75)(1514.8)}{6} = 277.7 \text{ K}$$

$$T < 0.7 \text{ sec}$$

$$F_t = 0$$

$$F_x = \frac{V w_x h_x}{\sum w_i h_i}$$

LEVEL	h, ft	w _x , K	w _x h _x	F _x , K	V _x , K	M _x
ROOF	20	208.8	4176	91.49	91.49	914.9
2 ND	10	850	8500	186.21	277.7	4606.8
1 ST	0	456	12676	277.7		
		1514.8				

OVERTURNING

$$M_{\text{SEISMIC}} = 4606.8 \text{ K-Ft}$$

BLDG

$$M_{\text{RESIST.}} = 1514.8 \text{ K} \times \frac{2}{3} \times 15 \text{ Ft} = 15,148 \text{ K-Ft}$$

$$M_R > M_{\text{SEIS.}} \quad \underline{\underline{\text{OK}}}$$

$$M_{\text{SEISMIC}} = 914.9 \text{ K-Ft}$$

ROOF

$$M_{\text{RESIST}} = 208.8 \text{ K} \times \frac{2}{3} \times 15 = 2088 \text{ K-Ft} > M_s \quad \underline{\underline{\text{OK}}}$$

FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project HSR	By R SILVA	Checked	Pkg.
Feature ANNEX	Date	Date	Account

DIAPHRAGM SHEARS, ANNEX

USING THE TOTAL FORCE TRIBUTARY TO THE DIAPHRAGM. THIS IS CONSERVATIVE, SINCE THE FORCE AT THAT POINT CAN BE REDUCED BY THE RATIO OF MASS THAT GENERATES SEISMIC FORCES AT THAT LEVEL TO TOTAL MASS AT THAT LEVEL,

$$F'_R = \frac{W'_R}{W_R} F_R$$

$$F_R = 91.49 \text{ K}$$

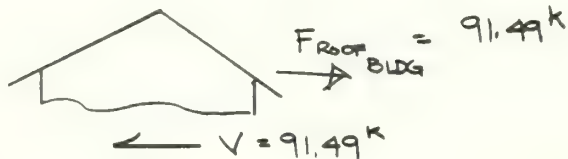
$$U_R = \frac{F_R}{L} = \frac{91.49}{120 \text{ ft}} = 762 \text{ p/f @ ROOF}$$

$$F_2 = 186.21 \text{ K}$$

$$U_2 = \frac{186.21}{120} = 1551 \text{ p/f @ 2ND FLOOR}$$

FORM D S C - 44

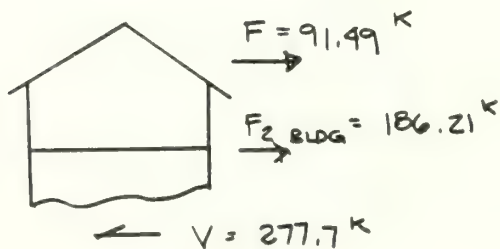
Park <u>DEVA</u>	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area			of
Project <u>HSR</u>	By <u>R SILVA</u>	Checked	Pkg.
Feature <u>ANNEX</u>	Date	Date	Account

WALL SHEARS, ANNEX2ND FLOOR

SIMPLIFY: USE 4 WALLS - 35 Ft PER WALL

$$V = \frac{91.49}{4} = 22.87 K$$

$$V = \frac{22.87 K}{35} = 653.5 \#/ft$$

1ST FLOOR

USE 8 - 25 Ft WALLS

$$V = \frac{277.7}{8 \times 25} = 1,388.5 \#/ft$$

FORM DSC-44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 1
Area			of 14
Project	BLDG DEAD LOADS	By D. TOWER	Checked
Feature	ROOF LOADS, MAIN HOUSE	Date	Pkg.
		Date	Account

ROOF LOADS, MAIN HOUSE
Lower Roof, Main Building

Assume timber wt. per cubic foot = 35 pcf

1x6 = 1.0 lb/ft
2x6 = 2.0 lb/ft
2x8 = 2.6 lb/ft
2x10 = 3.4 lb/ft
4x4 = 5.0 lb/ft
4x6 = 4.7 lb/ft

Clay Tile = 30 psf

1x6 Roof Boards
 $(\frac{12}{5.5})(1.0) = 2.18 \text{ psf}$

2x8 Top Chord
 $(\frac{12}{16})(2.6) = 1.95 \text{ psf}$

Dead Load on Top Chord:

30 psf (Tile)
+ 2.18 psf
+ 1.95 psf
34.13 psf

Roof load to walls (lb/ft of wall)

		Int wall	Ext. wall
4x6	= 4.7 lb/ft	4.7	2.35
4x4 @ 24" o.c. (14.5)(3.0)($\frac{12}{24}$)	= 21.75 lb/ft	21.75	10.88
1x6 (Bottom roof) (2.18)(14.5)	= 31.61 lb/ft	31.61	15.81
2x10 @ 24" o.c. = (15.5 ft)($\frac{12}{24}$)(3.4)	= 26.35 lb/ft	26.35	13.18
1x6 (Top Roof) (14.5)(2.18)	= 42.51 lb/ft	37.06	22.89
Tile (14.5)(30)	= 585 lb/ft	519	315.0
2x8 Brace (26)(8)($\frac{12}{32}$)	= 7.8 lb/ft	15.6	0
<u>TOTAL</u>		<u>646.8 lb/ft</u>	<u>380.11 lb/ft</u>

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FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 2
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Roof Loads, Main House
Upper Roof, main Building

Roof Loads, MAIN HOUSE, (CONT)

Longitudinal Truss
5-2x8

$$(5)(26) = 130 \text{ lb/ft} \Rightarrow 13 \text{ }^{15}\text{/ft} / 7.5 \text{ ft o.c.} = 1.73 \text{ psf}$$

Truss

Top chord - 2x8 @ 16" o.c. $\Rightarrow (2.6)(\text{}^{12}\text{/16}) = 1.95 \text{ psf}$

Ties 2x6 @ 16" o.c. $\Rightarrow (2.0)(\text{}^{12}\text{/16}) = 1.50 \text{ psf}$

1x6 boards $\Rightarrow (1.0)(\text{}^{12}\text{/5.5}) = 2.18 \text{ psf}$

Tile = 30 psf

Exposed Truss & Ceiling

Truss Top chord - 10x12 - 22.8 ¹⁵/ft
22.8 x 15 = 342 lbs

Bottom Chord - 10x12 $\Rightarrow 342 \text{ lbs}$

Brace - 8x10 - 14.8 ¹⁵/ft
14.8 (5) = 74 lbs

Built up section of
Bottom chord

$$2 - 4 \times 10 \times 2.5 \Rightarrow 6.7 \text{ plf}$$

$$= (5)(6.7) = 33.5 \text{ lbs}$$

8x10 vert. brace

end - (1)(14.8) = 14.8 lbs

center (2)(14.8)(¹/₂) = 14.8 lbs

6x6 purlins @ 2'-6" o.c. (6.3 ¹⁵/ft)

$$(1)(6.3)(\text{}^{12}\text{/30}) = 2.52 \text{ psf}$$

1x3 ceiling (0.4 plf)

$$(0.4)(\text{}^{12}\text{/2.5}) = 1.92 \text{ psf}$$

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FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet <u>3</u>
Area			of
Project	By	Checked	Pkg.
Feature <u>Roof Loads, Main House</u>	Date	Date	Account

Roof Loads, Main House (cont.)

Truss Total wt. (for $\frac{1}{2}$ length of truss)

342	
+ 342	
+ 74	
+ 33.5	
+ 14.8	
+ 14.8	
<hr/>	
821 lbs	

Trusses are at $10' 9\frac{1}{2}"$ o.c.
= 10.71 ft

$821 \text{ lbs} / 15 \text{ ft} = 54.73 \text{ PIF}$

$54.73 / 10.71 = 5.11 \text{ psf}$

Dead Load in psf:

(long. Truss)	1.73
(Truss Top chord)	1.45
(TIES)	1.50
(1x6)	2.18
(TILE)	30
(EXPOSED TRUSS)	5.11
(PURLINS)	2.52
(Cieling)	1.92
<hr/>	
47 psf	

Summary:

Upper Roof D.L. = 47 psf

Lower Roof D.L. = 34.13 psf.

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FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 4
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Floor Loads, Main House

Floor Loads, Main Building

2ND Floor

For Spanish sitting- & bed- rooms & Mr. & Mrs. Johnsons rooms,

Assume 4x10s @ 16" o.c. for subfloor framing (5.9 psf)

1x6 or 1x8 Flooring (2.2 psf)

Tile floor (23 psf)

Ceiling Below Spanish Bedroom { 1x8 redwood ceiling below (1.8 psf)
6x6 beams @ 4'6" o.c. below (1.4 psf)
6x6 Ridge beams below (6.3 psf) } 3.61

Ceiling Below Spanish Sitting Room { 1x8 R.W. Ceiling (2.2 psf)
6x6 R.W. BEAMS @ 5'-0" o.c. (Transv.) (1.3 psf)
6x10 Beams (Long.) @ Ridge 2 quarterspan (3'-6" o.c.) (3.1 psf) } 6.8

Ceiling Below Mrs. J's Room { 1x8 R.W. Ceiling (1.8 psf)
6x6 Transverse @ 5'-0" o.c. (2.2 psf)
6x6 Longit. 4ft from each wall & center (1.4 psf) } 5.4 ps

Ceiling below Mr. J's Room { 6x6 @ 2'-0" o.c. (3.2 psf)
6x6 ridge beam (0.4 psf)
Plaster ceiling (8 psf) } 11.6 psf

For Gallery

Front & back

Long 6x6 (2 @ 2'-0" o.c.) (3.2 psf)

Trans. 6x6 (1 @ 10'-0" o.c.) (1.63 psf)

1x3 flooring (2.2 psf)

Tile (23 psf)

29 psf

East side

Tile, 1x?, 6x6 @ 2' => 28 psf

West side

Tile, 1x?, Plaster 34.2 psf

* U.S. GPO: 1984-778-378

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 5
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Floor Loads, Main House
 Summary, 2nd Floor Dead Loads

Spanish Bedroom
 Subfloor + Tile flooring - 31.1 psf
 Ceiling below - 3.6 psf

Spanish sitting Room
 Subfloor + Tile flooring - 31.1 psf
 Ceiling below - 6.8 psf

Mr. Johnsons Room
 Subfloor + Tile flooring - 31.1 psf
 Ceiling below - 5.4 psf

Mrs. Johnsons Room
 Subfloor + Tile flooring - 31.1 psf
 Ceiling below - 11.6 psf

Gallery, front & back - 29 psf
 Gallery, west side - 40 psf
 Gallery, East side - 34 psf
 Veranda - 120 psf

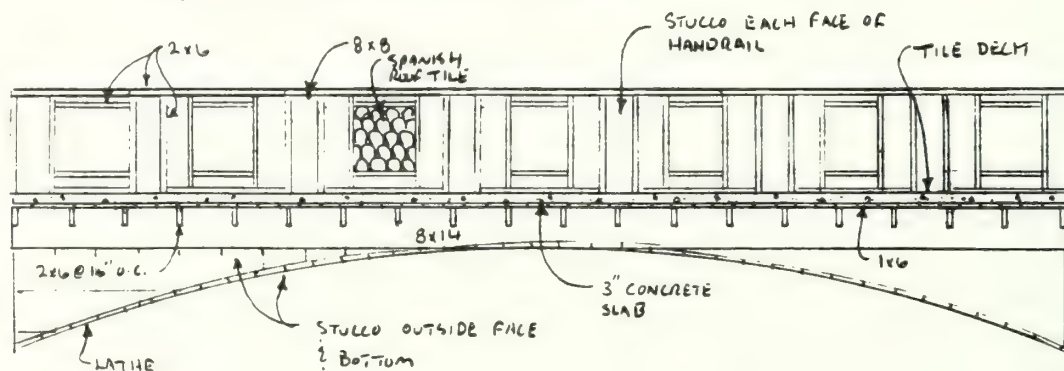
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FORM D & C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet <u>6</u>
Area			of
Project	By	Checked	Pkg.
Feature <u>BRIDGE LOADS</u>	Date	Date	Account

Bridge Loads

Bridge = 6'-0" wide outside dimensions



2x6 - 2.0 plf

Tile = 23 psf

1x6 - 1.0 plf

8x8 - 13.7 plf

8x14 - 24.6 plf

Spanish Tile - 20 psf

Concrete - 150 psf

Stucco - 20 psf

Assume rail frame x 2'-6" wall w/ 2x6 @ 10" o.c.

Rail Frame $\Rightarrow 2 + 2 + 2.25(2.0)(\frac{1}{2}/10) = 9.4$ plf per side $(2)(9.4)/6 = 3.1$ psf8x14's $\Rightarrow 8x14: 24.6$ plf $\Rightarrow (24.6)(2)/6 = 8.2$ psf2x6 floor @ 16" o.c. $\Rightarrow (2.0)(5)(\frac{1}{2}/16)/6 = 1.3$ psfSpanish roof tile $\Rightarrow (20 \text{ psf})(\text{app. } 1.5 \text{ ft}^2/\text{ft})/6 = 5$ psfTile $\Rightarrow 23 \text{ psf}$ 10 psfConcrete $\Rightarrow 50 \text{ psf}$ 30 psfStucco $\Rightarrow (1.5)(2) + 25 + (1.5)(25) - (1.5)(1.5)(7) = 41 \text{ psf}$

1x6 = 2.2 psf

Stucco $\Rightarrow (2)(1)(25) + (1.5)(25) + (1.5)(25) - (7)(1.5) = 25$

Total wt psf

3.1

8.2

1.3

5.0

2

23

10

50

38

41

25

2.2

~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~~~131 psf~~

• U.S. GPO: 1984-778-378

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 7
Area			of
Project	By	Checked	Pkg.
Feature Floor Load, Main House and Interior and exterior wall loads, Both Buildings	Date	Date	Account

FLOOR LOAD, MAIN HOUSE AND INTERIOR AND EXTERIOR WALL LOADS, BOTH BUILDINGS

1ST FLOOR, MAIN Building

Entire 1ST Floor is 6" CONCRETE SLAB with Tile flooring

Conc. = 75 psf
 Tile = 23 psf
98 psf

Exterior Walls, MAIN Building and Annex

From inside out:

Plaster, 2x6 @ 16" O.C., ~~Stucco~~, INSULEX, ~~2x6 @ 12" O.C.~~, 3" x 12" x 12" TILE, Stucco

Plaster = 8 psf
 2x6 @ 16" O.C. = 1.5 psf
~~Stucco = 20 psf~~
 Insulex ≈ 0
~~2x6 @ 12" O.C. = 2.0 psf~~
 3" Tile = 15 psf
 Stucco = 20 psf
44.5 psf

Interior Walls, Both buildings

Plaster, 2x4 @ 16" O.C., Plaster
 $8 + 1.3 (12/16) + 8 = 9 \text{ psf}$

* U.S. GPO: 1984-778-378

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 8
Area			of
Project	By	Checked	Pkg.
Feature <i>Roof & 2nd Floor Loads, Annex</i>	Date	Date	Account

ROOF AND 2ND FLOOR LOADS, ANNEX

Annex

Roof:

NO STRUCTURAL info. therefore assume roof dead loads to be approximately equal to main building

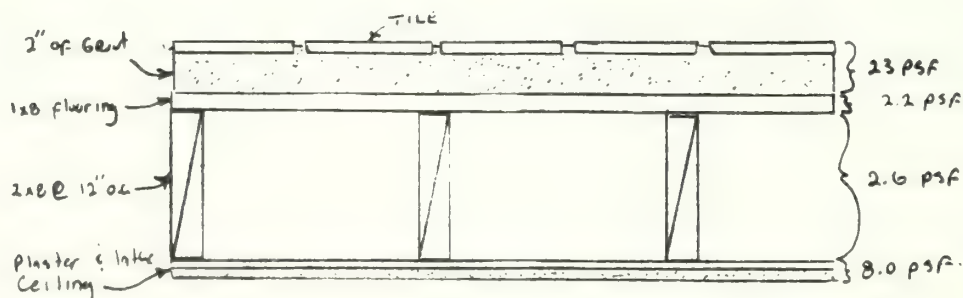
⇒ Roof Dead load for annex = 35 psf

2nd Floor Floor

No structural info. drawings available, only photos which appear to show 2x8's @ either 12" or 16" o.c. The main building uses 2x10's or 4x10's for Dead load, assume 2x8's @ 12" o.c.

Except for each end of the building, which have wood and beam 1st floor ceilings, the ceilings below the 2nd floor sub-floor are plaster. Therefore, for dead load calculations assume plaster ceilings throughout

A typical floor section is shown below:



35.8 psf

2nd Floor, Ceiling

Plaster ceiling - 12 psf

Music Room - 8 psf

OTHER wood ceilings - 5.5 psf

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 1
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

1st Floor:

ONLY INFO is from HABS

Assume 2x8 @ 12" o.c. w/ 1x8 flooring

(NO TILE, Exposed joists below)

D.L. : $26 \text{ lb/ft}^2 + 2.2 \text{ lb/ft}^2$

: 4.8 psf

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FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet <u>10</u>
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Total Building Weight:

Main Building

★ Upper Roof - $A = 46 \text{ ft} \times 40 \text{ ft} = 1840 \text{ ft}^2$

$W = (47 \text{ psf (page 2)}) (1840) = \underline{86,480 \#}$ (inc. ceiling)

★ Lower Roofs - $A = 2(40 \times 25) = 2000 \text{ ft}^2$

$(34.13 \text{ psf}) (2000 \text{ ft}^2) \quad W = \underline{68,260 \#}$

★ Ceilings below lower roofs

6x6 @ 2'-0" o.c. \Rightarrow	3.2 psf
6x6 Ridge beam \Rightarrow	.4 psf
1x8 Boards \Rightarrow	1.8 psf
Total	<u>5.4 psf</u>

Area:

$(26)(17)(2) + (15)(15)(2) + (2)(98) = 1530 \text{ ft}^2$

Load: $(1530)(5.4) = \underline{8262 \#}$

Plaster ceilings: $(8 \text{ psf})(2)(10)(15)$

$W = \underline{2400 \#}$

★ Veranda Roof:

$A = (33)(14) = 462 \text{ ft}^2$

Solid 2x4 $\Rightarrow (1.3 \text{ plf})(12/3.5) = 4.5 \text{ psf}$

$W = \underline{(462)(4.5) = 2060 \#}$

2nd Floor (subfloor & 1st floor ceiling)

Mr. J's Room, bath, & closet

$A = (15.33)(15.33) + (8)(10) + (6.33)(10) = 378 \text{ ft}^2$

$W = 31.1 \text{ psf} + 11.6 \text{ psf} = (42.7 \text{ psf})(A)$

$W = (42.7)(378) = \underline{16,154 \#}$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 11
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Mrs. J's Room

$$A = (15.2)(25) = 380 \text{ ft}^2$$

$$W = (380)(31.1 + 6.4) = \underline{13,870 \text{ \#}}$$

Gallery:

$$A_1 = (42 + 42)5 = 420 \text{ ft}^2 \text{ (Front \& Back)}$$

$$A_2 = (22)(6) = 132 \text{ ft}^2 \text{ (West)}$$

$$A_3 = (22)(5) = 110 \text{ ft}^2 \text{ (East)}$$

$$W = (420)(29) + (132)(34.2) + (110)(28) \\ = \underline{19,774 \text{ \#}}$$

Spanish sitting Room:

$$A = (15.33)(25.93) = 396 \text{ ft}^2$$

$$W = (396)(31.1 + 6.8) = \underline{15,007 \text{ \#}}$$

Spanish Bdrm., Closet, \& Bath

$$A = (15.2)(15.33) + (6.33)(10) + (9)(10) \\ = 376 \text{ ft}^2$$

$$W = (376)(31.1 + 3.6) = \underline{13,061 \text{ \#}}$$

Veranda:

$$A = (2)(31.2) = 374 \text{ ft}^2$$

$$W = (374)(120) = \underline{44,880 \text{ \#}}$$

Interior Walls

$$L = 31 + 26 + 10 + 10 + 31 + 22 + 10 + 10 = 150 \text{ ft}$$

$$A = (150)(4.5) = 1425 \text{ ft}^2$$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 12
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

$W = (1425)(9 \text{ psf}) = \underline{12,825 \#}$

Exterior Walls. (1st & 2nd Floor)

East Elev.

$$A = [(33)(23) + (.5)(33)(3)] - [(3)(4)(5) + (3)(7)]$$

$$+ (13)(17) - [(7)(7) + \frac{(\pi)(7)^2}{4(2)}] + (6)(6.5) + (9)(1.5) + (5)(8)(7)$$

$$+ (1)(17) + (8)(6)$$

$$= 1026 \text{ ft}^2$$

$$W = (1026)(44.5)$$

$$= \underline{45,646 \#}$$

South Elev.

$$A = [(98)(23) + (46)(1) + (24)(18) + (33)(16) + (9)(11) + (11)(13)]$$

$$- [(3)(5)(5) + (3)(4)(4) + (8)(7) + (12)(4) + (4)(4) + (3)(4) + (25)(7)]$$

$$+ (6)(6) + 3[(7)(7) + \frac{\pi(7)^2}{4(2)}] + (3)(4) + (7)(6) + (8)(4)$$

$$+ 2(3)(4) + (3)(5)]$$

$$= 3502 - 796 = 2706 \text{ ft}^2$$

$$W = (2706)(44.5) = \underline{120,417 \#}$$

West Elev.

Same as East plus Solarium

$$A_{\text{solarium}} = (8)(18) + (8)(12) - 2(4)(5) = 200 \text{ ft}^2$$

$$A_{\text{solarium}} = (8)(5)(8)(10) = 320 \text{ ft}^2$$

$$W = (45,646) + (200)(44.5) + (320)(35) = \underline{65,746 \#}$$

FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 13
Area			of
Project	By	Checked	Pkg.
Feature	Date	Date	Account

NORTH Elev.

$$A = [(98)(23) + (44)(11) + (8)(13) + (9)(13) + (12)(13) + 3(5)(9)]$$

$$- [2(7)(4) + (3)(4)2 + 6(3)(5) + 6(3)(4) + (3)(6) + 2(7)(6) + (2)(\frac{7(7)^2}{2(4)})]$$

$$A = 2797 - 382.5 = 2414.5$$

$$W = 2414.5 (44.5)$$

$$= \underline{107,446 \#}$$

1st Floor

$$A = (109)(33) + (31)(11) + (9\frac{5}{12})(20\frac{1}{12}) + \frac{(17)(17)}{2}$$

$$= 4260 \text{ ft}^2$$

$$W = (4260)(98)$$

$$= \underline{417,453 \#}$$

1st Floor INT. WALLS

$$A = 12(25 + 16 + 21) = 744 \text{ ft}$$

$$W = (744)(9) = \underline{6696 \#}$$

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FORM D S C - 44

Park	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet 14
Area			of 14
Project	By	Checked	Pkg.
Feature	Date	Date	Account

Total WT. , main bldg

86480

68260

8262

2400

2060

16154

13870

14774

15007

13061

44880

12825

45646

120417

67746

107546

417453

6696

65746

1,068,437 lbs

or 1068 Kips

1066 Kips

• U.S. GPO: 1984-778-378

FORM D S C - 44

Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area	SCOTTY'S CASTLE			of
Project	HSR	By	R SILVA	Checked
Feature	MAIN HOUSE	Date		Date
				Pkg.
				Account

WIND, MAIN HOUSE

$$P = C_e C_q q_s I$$

$$I = 1.0$$

$$\text{EXPOSURE B} \quad h = 26 \text{ ft}$$

$$C_e = 0.8$$

$$\text{WIND SPEED} \quad 75 \text{ mph}$$

$$q_s = 15 \text{ psf}$$

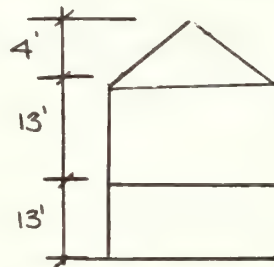
$$C_q = 1.3$$

$$P = 0.8 (1.3) (15) (1) = 15.6 \text{ psf}$$

$$\text{USE } 16 \text{ psf}$$

$$W_{\text{ROOF}} = 16 \text{ psf} \times \left(\frac{13 \text{ ft}}{2} + 4 \right) = 168 \text{ plf}$$

$$W_{2\text{ND FL}} = 16 \text{ psf} \times \left(\frac{13}{2} + \frac{13}{2} \right) = 208 \text{ plf}$$

2ND FLOOR WALLSEND WALLS

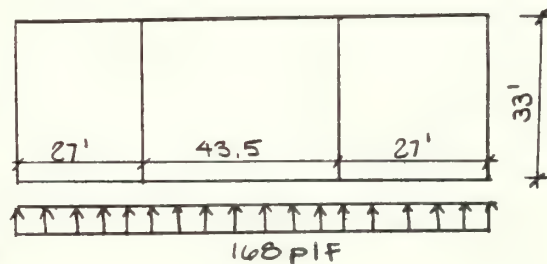
$$R = 168 \times \frac{27}{2} = 2268 \#$$

$$V = \frac{2268 \#}{33 \text{ ft}} = 68.7 \#/\text{ft}$$

INTERIOR WALLS

$$R = 168 \left(\frac{27}{2} + \frac{43.5}{2} \right) = 5922 \#$$

$$V = \frac{5922 \#}{33 \text{ ft}} = 179.5 \#/\text{ft}$$



FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet of
Area SCOTTY'S CASTLE	By R SILVA	Checked	Pkg.
Project HSR	Date	Date	Account
Feature MAIN HOUSE			

1ST FLOOR WALLS, MAIN HOUSE

$$R_{2^{nd} FL} = 208 \left(\frac{27}{2} \right) = 2808 \#$$

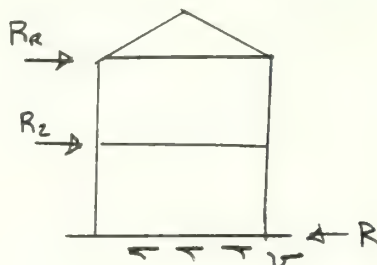
$$R = 2808 + 2268 = 5076 \#$$

$$V = \frac{5076}{33} = 154 \# / ft \text{ END WALLS}$$

$$R_2 = 208 \left(\frac{27}{2} + \frac{43.5}{2} \right) = 7332 \#$$

$$R = 7332 + 5922 = 13,254 \#$$

$$V = \frac{13254}{33} = 402 \# / ft \text{ INTERIOR WALLS}$$



BY INSPECTION: FOR ANNEX BUILDING
WIND SHEAR < SEISMIC

FORM D S C - 44

Park	DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet	
Area	SCOTTY'S CASTLE			of	
Project	HSR	By	R SILVA	Checked	Pkg.
Feature		Date		Date	Account

BASE SHEAR FROM MAXIMUM PEAK GROUND MOTION VALUES FROM UNDERGROUND NUCLEAR TESTS AT THE NEVADA TEST SITE AND EARTHQUAKES THAT WERE RECORDED AT SCOTTY'S CASTLE FROM 1982 TO 1989,

MAX. VALUES FROM COMSTOCK EVENT
DATE 6/2/88

USING $g = 0.0106$ NORTH ACCEL.

$$V = \frac{0.0106(2.75)(1066)}{8} = 3.88^k$$

$V = 3.88^k$ CONSIDERABLY LESS THAN DESIGN
BASE SHEAR OF $V = 146.6^k$

FORM D S C - 44

Park DEVA	NATIONAL PARK SERVICE DENVER SERVICE CENTER		Sheet
Area SCOTTY'S CASTLE			of
Project HSR	By R SILVA	Checked	Pkg.
Feature	Date	Date	Account

BLDG PERIODS (BASED ON DIMENSIONS)MAIN HOUSE

$$T = \frac{0.05 h_n}{D^{1/2}} = \frac{0.05 (26 \text{ FT ROOF})}{(33)^{1/2}}$$

$$T = 0.23 \text{ TRANSVERSE DIRECTION}$$

$$T = \frac{0.05 (26)}{(110 \text{ FT AVG})^{1/2}} = 0.12 \text{ LONGIT. DIRECTION}$$

ANNEX

$$T = \frac{0.05 (20)}{(25)^{1/2}} = 0.20 \text{ TRANS}$$

$$T = \frac{0.05 (20)}{(120)^{1/2}} = 0.09 \text{ LONGIT.}$$

SOIL NATURAL PERIOD

T RANGES FROM 0.5 TO 1.0 FOR
A STIFF SOIL

BRIDGE PERIOD

$$T = \frac{0.05 (12.67)}{(25)^{1/2}} = 0.13 \text{ LONGIT.}$$

$$T = \frac{0.05 (12.67)}{(6)^{1/2}} = 0.26 \text{ TRANS}$$

APPENDIX D, UNITED STATES GEOLOGICAL SURVEY SEISMIC DATA

FILE CREATED: 5-SEP-1991 13:14:26.05
 Circle Search Earthquakes= 1079
 Latitude: 37.000N Longitude: 117.500W
 Radius: 175.000 km
 Year: 1930 - 1991
 Magnitude: 4.0 - 9.9
 Selected Earthquakes With Known Magnitude Estimates
 Selected Catalogs: HDS CDMG
 Duplicate Eliminator Used: Time separation (sec) =
 Acceptable Catalog(s): CDMG HDS

Distance separation (km) = 15.0000

Time separation (sec) = 10.0000

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S**** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	****INFORMATION**** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1930	04 06 042300.00B	36.830 -118.250				4.50UKTO	039	.F.....P.	69
CDMG	1930	05 29 071216.00	35.500 -117.230				4.10MLRI	039	.F.....P.	168
CDMG	1930	07 07 120900.00	35.700 -117.800				4.50UKTO	039 G	.F.....P.	146
CDMG	1930	08 11 130000.00B	36.580 -118.070				4.00UKTO	039	5.....P.	68
CDMG	1931	01 17 080720.60	37.580 -118.050				4.10MLRI	040 A	.....P.	80
CDMG	1931	09 23 082500.00B	37.080 -118.170				4.50UKTO	040	6.....P.	60
CDMG	1931	11 25 121800.00	37.200 -118.250				4.00UKTO	040	5.....P.	70
CDMG	1932	03 23 002014.10P	35.600 -116.967				4.00MLPAS	039 B	.F.....P.	162
CDMG	1932	05 22 081656.10P	37.333 -117.500				4.00MLPAS	040 C	.....P.	36
CDMG	1932	07 26 065158.30P	35.800 -118.533				4.50MLPAS	039 B	6.....P.	162
CDMG	1932	08 03 054725.00B	38.000 -117.000				4.00MLBRK	037 D	.....P.	119
CDMG	1932	08 24 090838.00B	37.330 -118.820				4.00MLBRK	040 C	.....P.	122
CDMG	1932	10 25 032800.00P	37.333 -118.667				4.50MLPAS	040 E	.....P.	109
CDMG	1933	01 02 013400.00P	38.000 -118.000				4.50MLPAS	040 C	.....P.	119
CDMG	1933	02 03 014800.00P	37.333 -118.833				4.00MLPAS	040 E	4.....P.	123
CDMG	1933	02 26 065500.00P	36.000 -118.167				4.00MLPAS	039 E	.....P.	125
CDMG	1933	06 22 123628.00P	37.583 -118.800				4.90MLPAS	040 D	4.....P.	132
CDMG	1933	06 22 124102.00P	37.583 -118.800				4.90MLPAS	040 D	4.....P.	132
CDMG	1934	01 30 201631.00B	38.280 -118.360				6.30MLBRK	040 A	9.....P.	160
CDMG	1934	03 13 161100.00B	38.000 -118.000				4.50MLBRK	040 D	3.....P.	119
CDMG	1934	03 13 162000.00B	38.000 -118.000				5.00MLBRK	040 D	.F.....P.	119
CDMG	1934	03 19 104100.00B	38.000 -118.000				4.50MLBRK	040 D	4.....P.	119
CDMG	1934	03 23 224900.00B	38.000 -118.000				4.50MLBRK	040 D	.....P.	119
CDMG	1934	04 02 080500.00B	38.000 -118.000				4.50MLBRK	040 D	.....P.	119
CDMG	1934	04 18 024800.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	06 01 055500.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	06 12 202700.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	09 13 184000.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	11 30 193100.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	12 04 061700.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1934	12 31 055100.00B	38.000 -118.000				4.00MLBRK	040 D	4.....P.	119
CDMG	1935	01 21 000900.00B	38.000 -118.000				4.00MLBRK	040 D	.....P.	119
CDMG	1935	02 08 042200.00P	35.833 -118.000				4.00MLPAS	039 B	5.....P.	136
CDMG	1935	03 03 054900.00P	38.000 -118.000				4.00MLPAS	040 D	.....P.	119
CDMG	1935	04 18 060700.00P	37.900 -118.533				4.00MLPAS	040 C	.....P.	135
CDMG	1935	05 16 032500.00P	37.383 -118.917				4.50MLPAS	040 B	4.....P.	132

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	F-E STA REG	*****INFORMATION***** IEMFDIPL PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1935	06 06	193300.00B				040 D	.....P.....	119
CDMG	1935	06 11	162046.30P				039 A	5.....P.....	159
CDMG	1935	06 19	095500.00P				040 C	5.....P.....	93
CDMG	1935	06 19	100700.00P				040 C	4.....P.....	93
CDMG	1936	01 11	064900.00B				040 D	.....P.....	119
CDMG	1936	01 14	053000.00B				037 D	.....P.....	119
CDMG	1936	01 30	183200.00P				040 D	.....P.....	119
CDMG	1936	03 26	224300.00B				040 D	.....P.....	119
CDMG	1936	04 19	201900.00B				040 D	.....P.....	119
CDMG	1936	04 24	190000.00B				040 B	.....P.....	102
CDMG	1936	05 03	142101.80P	10			039 B	.....P.....	160
CDMG	1936	05 10	174013.20P	10			040 D	6.....P.....	102
CDMG	1936	05 15	043400.00P				040 C	5.....P.....	107
CDMG	1936	07 02	014000.00B				040 D	.....P.....	119
CDMG	1936	07 11	034700.00P				039 C	4.....P.....	65
CDMG	1936	07 25	193900.00P				040 D	4.....P.....	119
CDMG	1936	10 06	123300.00P				040 C	F.....P.....	107
CDMG	1936	10 07	030100.00P				040 C	F.....P.....	107
CDMG	1936	10 07	150100.00B				040 D	.....P.....	119
CDMG	1936	10 10	184900.00P				040 C	4.....P.....	130
CDMG	1936	10 21	150400.00B				040 D	.....P.....	119
CDMG	1936	10 26	123400.00B				040 D	.....P.....	119
CDMG	1937	01 19	235738.50P	10			039 A	F.....P.....	162
CDMG	1937	02 12	22657.10P	10			040 C	F.....P.....	84
CDMG	1937	02 19	090900.00B				040 C	5.....P.....	160
CDMG	1937	02 19	230600.00P				040 D	F.....P.....	119
CDMG	1937	02 28	181700.00P				040 D	F.....P.....	119
CDMG	1937	03 09	154137.90P	10			040 C	F.....P.....	144
CDMG	1937	06 27	042600.00P				040 C	F.....P.....	95
CDMG	1937	08 19	070300.00P				040 D	5.....P.....	119
CDMG	1937	09 10	193400.00P				039 B	.....P.....	120
CDMG	1937	09 18	083700.00P				039 B	.....P.....	120
CDMG	1937	09 25	122000.00P				040 C	.....P.....	115
CDMG	1938	03 14	212100.00B				040 D	.....P.....	119
CDMG	1938	07 26	063457.90P	4			039 C	.....P.....	165
CDMG	1938	09 17	142304.10P				039 C	F.....P.....	151
CDMG	1938	09 23	082000.00P				040 D	.....P.....	119
CDMG	1938	12 03	174252.60P	10			040 A	6.....P.....	110
CDMG	1938	12 03	174500.00P				040 B	F.....P.....	125
CDMG	1938	12 03	175700.00P				040 C	F.....P.....	125
CDMG	1938	12 03	184116.40P	10			040 C	F.....P.....	115
CDMG	1938	12 03	221700.00P				040 C	F.....P.....	125
CDMG	1938	12 03	222000.00P				040 C	F.....P.....	125
CDMG	1938	12 04	184900.00P				040 C	F.....P.....	125
CDMG	1938	12 16	104800.00P				040 C	F.....P.....	109
CDMG	1939	01 07	202150.20P	10			040 A	F.....P.....	111
CDMG	1939	04 03	071000.00P				039 C	.....P.....	142
CDMG	1939	05 11	024200.00P				040 D	.....P.....	119
CDMG	1939	05 17	034200.00P				040 C	F.....P.....	107
CDMG	1939	05 21	195900.00P				040 C	F.....P.....	107

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	**COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1939	06 13	171500.00P							
CDMG	1939	08 15	154818.00P				5.00MLPAS	040 B	F.....P.	22
CDMG	1939	09 21	091700.00P				4.00MLPAS	040 B	.....P.	111
CDMG	1939	11 05	161400.00B				4.00MLPAS	040 D	.....P.	44
CDMG	1939	12 01	130505.10P				4.00MLBRK	040 D	.....P.	119
CDMG	1939	12 19	201209.00P	4			4.00MLPAS	040 C	F.....P.	72
CDMG	1939	12 30	050047.60P				4.00MLPAS	039 C	.....P.	131
CDMG	1940	02 24	093800.00P	5			4.00MLPAS	039 A	.....P.	141
CDMG	1940	03 25	211818.00P				4.50MLPAS	040 C	F.....P.	107
CDMG	1940	04 08	133439.00P				4.00MLPAS	040 D	.....P.	41
CDMG	1940	05 08	174000.00P				4.00MLPAS	040 B	F.....P.	103
CDMG	1940	07 08	105736.50P				4.00MLPAS	040 C	.....P.	131
CDMG	1940	07 22	230032.90P				4.80MLPAS	040 A	F.....P.	133
CDMG	1940	07 22	230032.90P				4.60MLPAS	040 A	F.....P.	132
CDMG	1941	05 08	145340.00P				4.00MLPAS	040 C	.....P.	107
CDMG	1941	06 06	193848.00P				4.00MLPAS	041 D	.....P.	151
CDMG	1941	09 14	164331.80P				5.80MLPAS	040 A	7.....P.	126
CDMG	1941	09 14	165458.00P				4.50MLPAS	040 B	F.....P.	126
CDMG	1941	09 14	182118.70P				5.50MLPAS	040 A	6.....P.	126
CDMG	1941	09 14	183911.90P				6.00MLPAS	040 A	6.....P.	126
CDMG	1941	09 14	185418.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1941	09 14	211601.00P				5.00MLPAS	040 B	F.....P.	126
CDMG	1941	09 27	194837.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1941	09 28	150514.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1941	10 23	204431.00P				4.50MLPAS	040 B	F.....P.	126
CDMG	1941	10 24	174857.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	11 04	020928.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	11 15	164305.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1941	12 18	205900.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1941	12 31	064844.00P				5.40MLPAS	040 A	6.....P.	126
CDMG	1941	12 31	080815.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	12 31	110225.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	12 31	111457.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	12 31	122015.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1941	12 31	180544.00P				4.50MLPAS	040 B	F.....P.	126
CDMG	1942	01 01	034101.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1942	02 04	032115.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1942	02 04	032526.00P				4.50MLPAS	040 B	F.....P.	126
CDMG	1942	02 04	033203.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1942	02 26	183239.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1942	02 27	012250.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1942	06 05	031938.00P				4.00MLPAS	040 B	F.....P.	126
CDMG	1942	06 22	221351.00P				4.00MLPAS	040 C	.....P.	126
CDMG	1942	06 22	235103.00P				4.00MLPAS	040 B	.....P.	126
CDMG	1942	07 06	211140.00P				4.00MLPAS	040 B	F.....P.	93
CDMG	1942	07 08	100547.00P				4.50MLPAS	040 C	4.....P.	126
CDMG	1942	08 20	111148.00P				4.00MLPAS	040 C	.....P.	126
CDMG	1942	08 20	120938.00P				4.00MLPAS	040 C	.....P.	126
CDMG	1942	08 20	152631.00P				4.00MLPAS	040 C	.....P.	126
CDMG	1942	08 21	233641.00P				4.00MLPAS	040 C	.....P.	126
CDMG	1942	09 07	195011.00P				4.00MLPAS	040 C	.....P.	126

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****A G N I T U D E S***** mb OBS Ms	F-E STA REG	*****INFORMATION***** ITEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1942	10 16	100727.00P				040 C	.....P.	93
CDMG	1942	10 30	005518.00P				040 C	.F.....P.	126
CDMG	1942	12 05	185207.00P				040 B	.....P.	126
CDMG	1943	01 01	222417.00P				040 C	.....P.	126
CDMG	1943	02 18	145319.00P				040 C	.....P.	126
CDMG	1943	05 30	075054.00P				040 C	.....P.	104
CDMG	1943	05 31	201653.00P				040 C	4.....P.	106
CDMG	1943	06 22	153121.00P				040 C	6.....P.	119
CDMG	1943	07 10	031233.00P				040 C	.....P.	155
CDMG	1943	08 09	053004.00P				039 C	5.....P.	146
CDMG	1943	09 16	001611.00P				040 C	6.....P.	115
CDMG	1943	09 16	075222.00P				040 C	.....P.	115
CDMG	1943	11 03	042339.00P				040 C	.....P.	126
CDMG	1943	12 17	001925.00P				040 C	4.....P.	69
CDMG	1943	12 17	043800.00P				040 C	.F.....P.	69
CDMG	1944	06 08	011155.00P				040 C	5.....P.	119
CDMG	1944	08 09	140106.00P				040 C	.....P.	125
CDMG	1944	08 12	082520.00P				039 C	.....P.	120
CDMG	1944	11 17	003249.00P				040 C	.....P.	85
CDMG	1944	12 23	081622.00P				040 C	.F.....P.	76
CDMG	1945	05 08	180846.00P				040 A	4.....P.	109
CDMG	1945	05 18	094440.00P				040 C	5.....P.	118
CDMG	1945	06 14	033013.00P				039 C	.....P.	9
CDMG	1945	07 26	101058.80P				040 C	.....P.	108
CDMG	1945	07 30	060610.00P				040 C	.....P.	53
CDMG	1945	08 17	202114.00P				040 C	.....P.	106
CDMG	1945	09 04	111356.00P				040 C	.....P.	66
CDMG	1946	01 13	163115.00P				040 C	.....P.	107
CDMG	1946	03 15	132100.90P				039 A	6.....P.	144
CDMG	1946	03 15	134935.90P				039 A	.F.....P.	149
CDMG	1946	03 15	140035.40P				039 A	8.....P.	151
CDMG	1946	03 15	150009.20P				039 A	.F.....P.	144
CDMG	1946	03 15	191853.60P				039 A	.F.....P.	148
CDMG	1946	03 15	215433.40P				039 A	.F.....P.	146
CDMG	1946	03 15	225402.00P				039 A	.F.....P.	148
CDMG	1946	03 16	094617.90P				039 C	.....P.	147
CDMG	1946	03 16	130705.00P				039 A	.F.....P.	148
CDMG	1946	03 16	195359.00P				039 C	.....P.	148
CDMG	1946	03 17	060347.10P				039 C	.....P.	155
CDMG	1946	03 17	081636.00P				039 A	.F.....P.	166
CDMG	1946	03 17	144553.00P				039 C	.F.....P.	148
CDMG	1946	03 17	211835.00P				037 D	5.....P.	148
CDMG	1946	03 18	011509.00P				039 C	.....P.	148
CDMG	1946	03 18	030022.00P				039 C	.....P.	148
CDMG	1946	03 18	100555.10P				039 C	.....P.	149
CDMG	1946	03 18	154925.70P				039 A	4.....P.	140
CDMG	1946	03 18	155042.60P				039 C	.F.....P.	143
CDMG	1946	03 18	160346.00P				039 C	6.....P.	148
CDMG	1946	03 22	100833.00P				039 C	.....P.	148
CDMG	1946	03 24	025646.00P				039 C	.....P.	148

CATALOG SOURCE	D A T E YEAR	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	F-E STA REG	*****INFORMATION***** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1946	03 24 051727.80P	35.738 -117.981				039 A	.....P.	146
CDMG	1946	03 24 200003.00P	35.728 -118.099				039 A	.....P.	150
CDMG	1946	03 25 233644.90P	35.679 -118.077				039 A	.....P.	155
CDMG	1946	03 26 060713.00P	35.733 -118.033				039 C	.....P.	148
CDMG	1946	04 12 103433.70P	35.687 -117.869				039 B	.F.....P.	149
CDMG	1946	04 16 103704.70P	35.789 -118.204				039 A	.F.....P.	148
CDMG	1946	04 24 074608.20P	35.832 -118.046	7			039 C	.F.....P.	138
CDMG	1946	04 27 021824.00B	38.500 -118.000				040 D	.....P.	172
CDMG	1946	04 27 223723.80P	35.723 -117.891				039 C	.....P.	145
CDMG	1946	05 01 173010.00P	37.083 -118.000				040 C	.....P.	45
CDMG	1946	05 05 090343.70P	35.697 -117.836	2			039 C	.F.....P.	147
CDMG	1946	05 18 035500.00P	37.367 -118.833				040 C	.....P.	125
CDMG	1946	05 18 064548.00P	37.357 -118.833				040 C	.....P.	125
CDMG	1946	06 05 215932.40P	35.647 -118.345				039 A	.F.....P.	168
CDMG	1946	07 22 151932.90P	35.752 -117.744	5			039 B	.....P.	140
CDMG	1946	08 31 091012.80P	35.646 -117.895				039 A	.....P.	154
CDMG	1946	12 07 020229.00P	37.300 -117.300				040 D	.....P.	37
CDMG	1947	01 11 115748.00P	37.600 -118.433				040 C	.....P.	106
CDMG	1947	02 06 172040.10P	35.677 -118.067				039 A	.....P.	155
CDMG	1947	03 09 211045.20P	35.813 -117.669	0			039 C	.....P.	132
CDMG	1948	02 06 131413.00P	37.217 -117.900				040 C	.....P.	42
CDMG	1948	02 11 032928.30P	36.090 -118.870	11			039 A	.....P.	158
CDMG	1948	05 26 193512.20P	35.679 -117.955				039 A	.....P.	152
CDMG	1948	06 07 150522.00P	37.200 -118.700				040 C	.....P.	108
CDMG	1948	07 26 175001.40P	35.582 -118.159	4			039 A	.....P.	168
CDMG	1948	08 06 042257.00P	37.450 -118.583				040 C	.....P.	108
CDMG	1948	08 30 190221.00P	36.550 -116.167				040 C	.....P.	128
CDMG	1949	02 11 210524.00P	37.083 -117.750				040 C	.....P.	24
CDMG	1949	04 13 075826.00P	37.667 -118.383				040 C	.....P.	107
CDMG	1949	10 24 022233.00P	37.667 -118.300				040 C	.....P.	102
CDMG	1949	12 09 084118.00P	37.467 -118.367				040 C	.F.....P.	92
CDMG	1949	12 09 123902.00P	37.467 -118.367				040 C	.....P.	92
CGS	1950	01 13 050719.00	37.017 -116.483				041	.F.....P.	90
CDMG	1950	09 28 110322.00P	37.483 -118.583				040 C	.....P.	109
CDMG	1951	06 16 055256.00P	37.083 -117.083				040 C	.....P.	38
CDMG	1951	06 25 194541.70P	35.772 -117.948	12			039 A	.....P.	141
CDMG	1951	06 26 194541.70P	35.761 -117.953	8			039 A	.....P.	143
CDMG	1951	09 09 184935.00B	38.200 -118.700				040 D	.....P.	170
CDMG	1951	10 01 181959.00P	38.000 -118.833				040 C	.....P.	161
CDMG	1951	11 28 044950.00P	38.000 -119.000				040 D	.....P.	172
CDMG	1951	12 28 024927.00P	37.567 -118.583	8			040 B	.....P.	114
CDMG	1952	02 09 084330.90P	36.607 -117.905				040 C	.....P.	56
CDMG	1953	04 10 051144.00P	37.800 -118.200				040 D	.....P.	108
CDMG	1953	10 30 073545.00P	37.633 -118.300				040 C	.....P.	99
CDMG	1953	11 24 054606.00P	35.883 -116.967				039 B	.....P.	132
CDMG	1954	04 09 170738.00P	35.833 -116.633				039 C	.....P.	150
CDMG	1954	04 17 101140.00P	35.883 -116.967				039 B	.....P.	132
CDMG	1954	08 20 080145.00P	37.667 -118.667				040 C	.....P.	127
CDMG	1954	09 22 070155.00P	37.667 -118.667				040 C	.....P.	127
CDMG	1954	11 17 072357.40P	36.390 -117.910	9			040 B	.....P.	76

CATALOG SOURCE	D A T E YEAR	ORIGIN TIME	***COORDINATES*** LAT. LONG.	DEPTH km	pP DEV	*****M A G N I T U D E S***** mb OBS Ms	F-E STA REG	*****INFORMATION***** ITEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1954	12 31 165653.00P	37.600 -118.500				040 D	5.....P.	110
CDMG	1955	01 21 122101.60P	36.814 -118.015	1			039 C	4.....P.	50
CDMG	1955	02 13 002303.40P	36.924 -118.138				039 C	.....P.	57
CDMG	1955	06 10 182637.00P	37.500 -118.683				040 B	.....P.	118
CDMG	1955	11 08 024052.00P	37.500 -118.800				040 C	5.....P.	127
CDMG	1956	07 11 192206.70P	35.766 -117.948	12			039 A	4.....P.	142
CDMG	1956	08 12 040406.00B	38.100 -117.900				037 D	.....P.	127
CDMG	1956	08 12 040412.00P	38.041 -119.000				040 D	.....P.	172
CDMG	1957	03 08 132457.90P	35.687 -117.515	2			039 A	4.....P.	145
CDMG	1958	01 13 041727.00B	38.250 -118.370				040 C	.....P.	158
CDMG	1958	04 02 215437.00P	37.817 -118.583				040 C	.....P.	131
CDMG	1958	05 03 173600.00P	38.000 -118.000				040 D	.....P.	119
CDMG	1958	08 22 234202.00P	37.583 -118.467				040 C	.....P.	107
CDMG	1959	01 05 123603.20P	36.149 -118.025	2			039 B	5.....P.	105
CDMG	1959	01 16 001005.30P	36.131 -118.060	1			039 A	F.....P.	108
CDMG	1959	01 19 214600.10P	36.152 -118.067	0			039 A	4.....P.	106
CDMG	1959	01 28 180904.00P	36.800 -116.200				040 C	.....P.	117
CDMG	1959	06 06 163046.00P	37.333 -118.633				040 C	.....P.	107
CDMG	1959	06 18 002940.00P	37.550 -118.567				040 C	6.....P.	112
CDMG	1959	08 04 073659.00P	37.350 -118.550				040 C	6.....P.	100
CDMG	1959	08 04 074133.00P	37.350 -118.650				040 B	F.....P.	109
CDMG	1959	08 04 191235.00P	37.467 -118.650				040 C	5.....P.	114
CDMG	1959	08 28 015238.00B	38.100 -118.200				040 D	.....P.	136
CDMG	1959	10 24 153515.30P	35.745 -118.023	7			039 A	6.....P.	146
CDMG	1960	01 21 142956.00B	38.470 -117.880				037 C	.....P.	166
CDMG	1960	01 21 152721.00B	38.470 -117.880				037 C	.....P.	166
CDMG	1960	06 05 074707.00P	37.517 -118.733				040 C	6.....P.	123
CDMG	1960	09 08 184136.00P	37.500 -118.683				040 D	.....P.	118
CDMG	1961	01 28 081246.20P	35.778 -118.049	5			039 A	4.....P.	144
CDMG	1961	02 02 000416.00P	37.450 -118.633				040 B	5.....P.	112
CDMG	1961	02 02 000742.00P	37.417 -118.667				040 C	5.....P.	113
CDMG	1961	03 27 090040.00P	36.600 -116.300				040 D	.....P.	115
CDMG	1961	10 01 171632.00B	36.500 -117.000				040 D	.....P.	71
CDMG	1961	10 19 050943.90P	35.831 -117.761				039 A	7.....P.	131
CGS	1962	02 09 163000.10A	37.043 -116.038	0			041	.....E..	130
CDMG	1962	09 16 053616.00P	35.754 -118.044	3			039 B	6.....P.	146
CDMG	1962	11 06 115717.00P	37.500 -119.000				039	5.....P.	144
CDMG	1963	05 03 021444.10P	37.612 -118.893				040 C	.....P.	140
CGS	1963	07 20 191305.90	37.100 -115.600	25		4.1	041 008	.....P.	169
CDMG	1963	09 16 053616.00P	35.750 -118.050				039 B	5.....P.	147
CDMG	1963	11 06 115720.40P	37.517 -119.017				039 B	5.....P.	146
CGS	1963	11 16 115841.50	38.100 -117.000	15		4.0	037 006	.....P.	129
CDMG	1963	11 16 164810.20B	38.000 -117.090				037	.....P.	116
CGS	1963	11 16 225125.80	38.000 -117.000	15		4.1	037 007	.....P.	119
CDMG	1963	12 06 083421.50P	37.648 -118.396	1			040 C	6.....P.	107
CDMG	1964	03 09 020631.00P	37.600 -118.400				040	4.....P.	103
CDMG	1964	07 08 055542.20B	38.400 -118.400				040	.....P.	174
CDMG	1964	09 04 202024.80P	37.400 -118.600				040	5.....P.	107
CDMG	1964	10 30 175038.00P	37.700 -118.200				040	F.....P.	99
CDMG	1964	10 30 190309.30P	37.500 -117.800				040	6.....P.	61

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms OBS CONTRIBUTED VALUES	F-E STA REG	****INFORMATION**** EMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1964	10 30	230259.50P				040	F.....P.....	94
CDMG	1964	10 31	193524.70P				037	.....P.....	114
CDMG	1964	11 02	113855.70P				040	F.....P.....	79
CDMG	1964	11 12	200725.00P				040	F.....P.....	89
CDMG	1964	11 13	050459.60P				040	F.....P.....	64
CDMG	1964	11 23	235230.00P				040	F.....P.....	65
CGS	1965	05 25	004813.30	33		3.8	040 009	.....	28
CDMG	1965	09 22	214925.90P	7			040 C	.....P.....	98
CDMG	1965	11 01	171016.30P				040	.....P.....	94
CGS	1965	12 25	185953.80	33			041 008	.....	106
AEC	1966	02 03	181737.10A	0		4.1	041	.....	113
AEC	1966	02 24	155507.00A	0		4.3	041	.....E.....	99
CDMG	1966	04 17	070419.10P	0		4.8	040 C	.....P.....	112
AEC	1966	05 04	133217.00A	0			041	.....	122
AEC	1966	05 05	140000.00A	0		5.5	041	.....E.....	130
AEC	1966	05 12	193726.20A	0		4.2	041 023	.....E.....	127
AEC	1966	05 13	133000.00A	0		4.2	041	.....E.....	130
AEC	1966	05 19	135628.10A	0		5.6	041	.....E.....	128
CGS	1966	05 19	153717.90	0		5.8	041	.....E.....	124
AEC	1966	05 27	200000.00A	0		4.5	041 013	.....I.....	126
CGS	1966	09 11	192524.50	33		5.1	041	.....E.....	110
AEC	1966	09 29	144530.00A	0		4.0	040 010	.....	130
AEC	1966	12 13	210000.00A	0		4.1	041 011	.....E.....	139
AEC	1966	12 20	153000.00A	0		4.6	040	.....E.....	102
CGS	1966	12 22	173001.10	17		6.3	041	.....E.....	94
CGS	1967	01 05	121521.70	16		4.9	041 008	.....	97
CGS	1967	01 19	164500.10A	0		4.0	041 021	.....	122
CGS	1967	01 20	174004.10A	0		5.4	041 085	.....E.....	133
CGS	1967	02 08	151500.10A	0		5.2	041 062	.....E.....	130
CGS	1967	02 23	183400.00A	0		4.8	041 020	.....E.....	132
CGS	1967	02 23	185000.00A	0		4.4	041 019	.....E.....	128
CGS	1967	03 02	211133.10A	0		5.8	041 130	.....E.....	56
CDMG	1967	03 02	141248.80P	9		4.7	041 024	.....I.....	132
CGS	1967	03 02	150000.00A	0			040 B	.....P.....	100
CGS	1967	04 21	150900.00A	0		4.2	041 029	.....	94
CGS	1967	04 21	150900.00A	0		4.3	041 023	.....E.....	130
CGS	1967	05 10	134000.00A	0		5.0	041 051	.....E.....	134
CGS	1967	05 20	150000.00A	0		5.9	041 183	.....E.....	128
CGS	1967	05 23	140000.00A	0		5.7	041 144	.....E.....	104
CDMG	1967	05 23	201407.00P	0			041	.....P.....	100
CGS	1967	05 26	150000.00A	0		5.5	041 109	.....E.....	94
AEC	1967	08 18	201230.00A	0			041	.....E.....	130
CDMG	1967	08 18	201240.20B	1			041	.....P.....	69
CDMG	1968	01 21	053020.90P	0			040 B	.....P.....	110
CDMG	1968	01 04	094543.10B	0			040	.....P.....	69
CDMG	1968	02 06	004138.00B	0			040	.....P.....	135
CDMG	1968	02 06	034810.80B	0			040	.....P.....	134
CGS	1968	04 26	150000.10	0		6.3	041 197	.....E.....	94
CGS	1968	04 26	151452.00	33		5.1	041 007	.....	116
CGS	1968	04 26	153221.00	17		4.9	041 023	.....	91
CGS	1968	04 26	163517.00	5		4.9	041 030	.....	103

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S**** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION**** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CGS	1968	04 26 204219.00	37.200 -116.400	33		4.0		041 008		100
CGS	1968	04 28 042340.00	37.200 -116.500	33		4.0		041 015		91
CGS	1968	04 30 074903.00	37.300 -116.300	33		4.0		041 018		111
CGS	1968	05 17 141120.00*	37.629 -116.382	15	G	4.0		041 006		121
CGS	1968	09 06 140000.10A	37.135 -116.047	0	G	5.6		041 108	E..	130
CGS	1968	12 19 163000.00A	37.232 -116.477	0		6.3	6.40UKBRK	041 159	E..	94
CGS	1968	12 19 173022.80	37.203 -116.468	4	G	4.3		041 005		94
CGS	1968	12 19 191819.60	37.287 -116.379	4	G	4.1		041 007		104
CGS	1968	12 19 195401.20	37.211 -116.473	4	G	4.3		041 006		94
CGS	1968	12 19 222326.30	37.191 -116.490	4	G	5.0		041 015		92
CGS	1968	12 20 200820.40	37.244 -116.531	4	G	4.2	4.50UKBRK	041 016		90
CGS	1968	12 21 001425.20	37.325 -116.506	4	G	4.9	4.30UKBRK	041 044		95
CGS	1968	12 21 150459.50	37.289 -116.469	4	G	4.0	4.70UKBRK	041 011		96
CGS	1968	12 21 190734.10	37.260 -116.524	4	G	4.1		041 010		91
CGS	1968	12 22 095954.70	37.378 -116.283	4	G	4.2		041 015		115
CGS	1968	12 22 181053.10	37.246 -116.507	4	G	4.2	4.30UKBRK	041 021		92
CGS	1968	12 22 220724.10	37.183 -116.506	4	G	4.0		041 006		90
CGS	1968	12 27 032238.60	37.301 -116.435	4	G	4.1		041 010		100
CGS	1969	01 08 204457.40S	37.184 -116.508	4	G	4.0		040 014		65
CGS	1969	01 08 234919.20S	36.939 -116.770	4	G	4.1		041 008		92
CGS	1969	01 09 001318.00S	37.199 -116.492	4	G	4.1		041 010		96
CGS	1969	01 09 031600.40S	37.216 -116.446	4	G	4.1		041 010		96
CGS	1969	01 09 101357.60S	37.206 -116.443	4	G	4.2		041 020		87
CGS	1969	01 10 094121.50S	37.184 -116.538	4	G	4.4	4.60MLBRK	041 010		90
CGS	1969	01 10 170144.50S	37.183 -116.513	4	G	4.4		041 011		88
CGS	1969	01 10 171417.20S	37.187 -116.532	4	G	4.3		041 074	E..	115
CGS	1969	01 15 193000.00A	37.209 -116.225	0		5.3	5.00UKBRK	040 021		131
CGS	1969	01 22 150002.60	36.958 -116.028	20		4.6		041 040	E..	130
CGS	1969	01 30 150000.00A	37.053 -116.029	0		4.8	4.70UKBRK	041 007	E..	133
CGS	1969	03 18 144002.70	37.160 -116.006	33	N	4.4	4.00MLPAS	041 024	E..	130
CGS	1969	03 20 181200.00A	37.022 -116.030	0		4.6	5.00UKBRK	041 037	E..	126
CGS	1969	03 21 143000.00A	37.133 -116.085	0		4.9		041 074	E..	132
CGS	1969	04 30 170000.00A	37.090 -116.014	0		5.3		041 089	E..	94
CGS	1969	05 07 134500.00A	37.282 -116.501	0		5.8	5.70UKBRK	041 014	E..	140
CGS	1969	05 15 175959.30	37.031 -115.922	3		4.5	4.00MLBRK			
CGS	1969	05 27 141500.00A	37.075 -115.995	0		5.0	4.60MLPAS	041 059	E..	134
CGS	1969	06 12 140000.00A	37.008 -116.032	0		4.4	4.90MLBRK	041 024	E..	130
CGS	1969	06 26 160003.10	37.101 -116.049	28		4.4	4.40MLBRK	041 014		129
CGS	1969	07 16 130230.40A	37.119 -116.053	0		4.7	4.20MLBRK	041 025		129
CGS	1969	07 16 145500.00A	37.139 -116.087	0		5.6	4.70MLPAS	041 071	E..	126
CGS	1969	08 27 134500.00A	37.022 -116.038	0		4.7	5.30MLBRK	041 024	E..	130
CGS	1969	09 12 180220.40A	36.877 -115.928	0		4.5	4.40MLPAS	040 025	E..	140
CDMG	1969	09 12 180220.40B	36.670 -115.920	0			4.80MLPAS	040	P.	145
CGS	1969	09 16 143000.00A	37.314 -116.460	0		6.2	4.50MLBRK	041 188	E..	98
CGS	1969	09 16 153153.30S	37.315 -116.470	4		4.1	6.30MLPAS	041 006	E..	97
CGS	1969	09 16 154339.20S	37.307 -116.473	4		4.9		041 016		97

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.		DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms		F-E STA REG	****INFORMATION**** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG				RADIAL DIST km
CGS	1969	09 16	162353.80S	37.323 -116.488	4		4.4		041 015	3.70MLBRK	.....	.....	.....	96
CGS	1969	09 16	173114.70S	37.302 -116.505	4		5.0		041 023	4.20MLBRK	.....	.....	.....	94
CGS	1969	09 16	181539.30S	37.315 -116.483	4		4.6		041 022	4.20MLBRK	.....	.....	.....	96
CGS	1969	09 20	143003.30	37.149 -116.034	33 N		4.3		041 010	3.70MLBRK	.....	.....	.....	131
CDMG	1969	10 03	131010.30P	37.625 -118.926					040 C	4.90MLPAS	.....	.....	.....	144
CDMG	1969	10 03	233227.10P	36.260 -118.310	0				039 B	4.00MLPAS	.....	.....	.....	109
CGS	1969	10 08	143000.00A	37.257 -116.450	0		5.5		041 095	5.50MLBRK	.....	.....	.....	97
CGS	1969	10 29	193000.00A	37.122 -116.128	0		5.1		041 019	4.30MLPAS	.....	.....	.....	122
CGS	1969	10 29	200000.00A	37.138 -116.141	0		5.0		041 024	4.70MLPAS	.....	.....	.....	121
CGS	1969	10 29	220151.40A	37.143 -116.064	0		5.7		041 110	5.70MLPAS	.....	.....	.....	128
CGS	1969	11 21	145200.00A	37.014 -116.007	0		5.0		041 053	5.00MLBRK	.....	.....	.....	132
CGS	1969	12 05	170000.00A	37.180 -116.211	0		5.0		041 038	5.10MLPAS	.....	.....	.....	116
CGS	1969	12 17	150000.00A	37.084 -116.002	0		5.5		041 089	5.60MLPAS	.....	.....	.....	133
CGS	1969	12 17	151500.00A	37.006 -116.023	0		4.8		041 025	5.10MLPAS	.....	.....	.....	131
CGS	1969	12 17	224407.00	37.285 -118.234	6		4.2		040 011	3.30MLBRK	.....	.....	.....	72
CGS	1969	12 18	190000.00A	37.121 -116.031	0		5.2		041 060	5.20MLPAS	.....	.....	.....	131
CGS	1970	01 23	163000.00A	37.138 -116.037	0		4.6		041 017	4.40MLBRK	.....	.....	.....	130
CGS	1970	01 30	170000.10A	37.031 -116.031	0		4.6		041 026	4.70MLPAS	.....	.....	.....	130
CGS	1970	02 04	150000.00A	37.098 -116.026	0		5.6		041 093	5.80MLPAS	.....	.....	.....	131
CGS	1970	02 05	150000.00A	37.164 -116.039	0		4.7		041 029	4.70MLPAS	.....	.....	.....	131
CGS	1970	02 05	193704.00A	37.164 -116.039	0		4.3		041 019	.....	.....	.....	.....	131
CGS	1970	02 11	191500.00A	37.201 -116.205	0		4.6		041 023	4.80MLPAS	.....	.....	.....	117
CGS	1970	02 25	142838.00A	37.037 -116.000	0		5.2		041 057	4.60MLBRK	.....	.....	.....	133
CGS	1970	02 26	153000.00A	37.119 -116.066	0		5.3		041 070	5.60MLPAS	.....	.....	.....	128
CGS	1970	03 06	142400.90A	37.173 -116.092	0		4.5		041 018	4.80MLBRK	.....	.....	.....	126
CGS	1970	03 06	150000.20A	37.140 -116.035	0		4.3		041 012	4.80MLPAS	.....	.....	.....	131
CGS	1970	03 19	140330.00A	37.001 -116.023	0		4.1		041 031	4.30MLPAS	.....	.....	.....	131
CGS	1970	03 23	230500.00A	37.081 -116.021	0		5.5		041 097	5.40MLBRK	.....	.....	.....	131
CGS	1970	03 26	190000.20A	37.300 -116.534	0		6.5	15.3H	041 149	5.00MLPAS	.....	.....	.....	91
CGS	1970	04 21	143000.00A	37.055 -115.988	0		4.6		041 026	6.30MLBRK	.....	.....	.....	134
CGS	1970	04 21	150000.00A	37.113 -116.081	0		4.8		041 033	4.40MLPAS	.....	.....	.....	126
CGS	1970	05 01	141300.00A	37.059 -116.028	0		4.2		041 024	4.80MLBRK	.....	.....	.....	131
CGS	1970	05 01	144000.20A	37.133 -116.034	0		4.5		041 030	4.40MLPAS	.....	.....	.....	131
CGS	1970	05 05	153000.20A	37.217 -116.184	0		5.2		041 055	3.90MLPAS	.....	.....	.....	119
CGS	1970	05 15	133000.00A	37.164 -116.037	0		5.3		041 063	4.30MLPAS	.....	.....	.....	131
CDMG	1970	05 15	151938.00B	36.100 -116.000					040	4.80MLPAS	.....	.....	.....	167
CGS	1970	05 21	141500.00A	37.071 -116.013	0		5.1		041 065	4.00MLBRK	.....	.....	.....	132
CGS	1970	05 26	141600.20A	37.158 -116.213	0		5.0		041 022	4.60MLPAS	.....	.....	.....	115
CGS	1970	05 26	150000.00A	37.114 -116.113	0		5.6		041 120	4.30MLBRK	.....	.....	.....	123
CGS	1970	05 28	120003.30*	37.174 -116.030	33 N		4.2		041 009	5.10MLPAS	.....	.....	.....	132
CGS	1970	06 26	130000.00A	37.115 -116.085	0		4.3		041 016	4.60MLBRK	.....	.....	.....	126

CATALOG SOURCE	YEAR	D A T E MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** OBS Ms	F-E STA REG	***INFORMATION*** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
CDMG	1970	07 30	201636.10P	37 359 -116.453	8			041 C		101
NOS	1970	10 14	143000.00A	37 071 -116.005	0			041 161	P.	133
NOS	1970	11 05	150000.00A	37 030 -116.012	0	5.5		041 045	E.	132
NOS	1970	12 16	160000.10A	37 100 -116.008	0	5.1		041 078	E.	133
NOS	1970	12 17	160500.20A	37 129 -116.083	0	5.7		041 149	E.	126
NOS	1970	12 18	153000.20A	37 173 -116.099	0	5.2		041 063	E.	125
CDMG	1970	12 30	130449.30P	35 770 -117.586	8			039 A	P.	136
CDMG	1971	02 20	125744.00P	37 958 -118.635	8			040 C	P.	146
CDMG	1971	03 03	120516.00P	35 659 -118.378	4			039 B	P.	168
CDMG	1971	03 08	230807.70P	35 667 -118.404	5			039 B	P.	168
ERL	1971	06 16	145000.00A	37 033 -116.013	0	4.3		041 023	E.	132
ERL	1971	06 23	153000.00A	37 022 -116.023	0	4.8		041 040	E.	131
ERL	1971	06 24	140000.20A	37 147 -116.067	0	5.2		041 061	E.	128
NOS	1971	07 08	140000.10A	37 110 -116.051	0	5.5		041 110	E.	129
ERL	1971	08 05	175817.10	36 892 -115.974	4	4.3		040 023	3F	136
ERL	1971	08 18	140000.00A	37 057 -116.036	0	5.4		041 088	E.	130
ERL	1971	09 29	140000.00A	37 012 -116.007	0	4.4		041 030	E.	132
ERL	1971	10 08	143000.10A	37 114 -116.037	0	4.7		041 033	E.	130
ERL	1971	10 14	143003.10*	37 221 -116.071	33	4.4		041 009		129
ERL	1971	11 30	154503.40*	37 080 -116.070	39	4.7		041 019		127
ERL	1971	12 14	210959.20A	37 124 -116.096	0	4.7		041 038	E.	125
CDMG	1972	01 22	025718.50P	37 684 -118.263	8			040 C	P.	101
CDMG	1972	02 17	110959.50P	37 520 -118.415	8			040 B	P.	99
ERL	1972	02 17	190203.60	37 085 -116.076	33	4.6		041 020		126
ERL	1972	03 30	210001.20*	36 955 -116.033	10	4.6		040 010		130
ERL	1972	04 19	163200.00A	37 122 -116.083	0	4.6		041 022	E.	126
ERL	1972	05 02	191501.80	37 152 -116.204	20	5.0		041 055		116
ERL	1972	05 17	141000.20A	37 120 -116.088	0	4.4		041 033	E.	126
ERL	1972	05 19	170000.00A	37 064 -116.002	0	4.9		041 045	E.	133
CDMG	1972	07 04	082004.00P	35 805 -117.631	8			039 A	P.	133
ERL	1972	07 20	171600.20A	37 215 -116.183	0	5.0		041 062	E.	119
ERL	1972	07 25	133003.10*	36 920 -116.036	33	4.0		040 010		130
CDMG	1972	09 18	071428.30B	38 030 -118.100					P.	125
ERL	1972	09 21	153000.20A	37 082 -116.037	0	5.7	4.3H	040		130
ERL	1972	09 26	143000.20A	37 122 -116.085	0	4.4		041 150	E.	126
ERL	1972	12 21	201500.20A	37 140 -116.083	0	5.0		041 032	E.	126
ERL	1973	02 09	231034.40	36 841 -115.940	5			041 084	E.	126
CDMG	1973	02 09	231036.60P	36 696 -115.891	8			040 018	F	140
CDMG	1973	02 17	110959.50P	36 696 -115.891	8			040 C	P.	147
CDMG	1973	02 18	180445.50P	36 819 -115.928	8			040 B	P.	99
CDMG	1973	02 19	111522.40P	36 811 -115.777	8			040 B	P.	141
ERL	1973	03 08	161000.20A	37 103 -116.027	0	5.4		040 B	P.	154
ERL	1973	04 25	222500.00A	37 005 -116.028	0	4.7		041 139	E.	131
ERL	1973	04 26	151500.80*	37 006 -116.018	5	4.1		041 045	E.	130
ERL	1973	04 26	171500.20A	37 123 -116.059	0	5.6		041 007	E.	128
ERL	1973	05 24	133000.70*	37 156 -116.106	5	4.8		041 152	E.	125
ERL	1973	06 05	170000.20A	37 185 -116.215	0	5.1		041 014	E.	116
ERL	1973	06 06	130000.10A	37 245 -116.346	0	6.1		041 058	E.	106
ERL	1973	06 12	081549.90	37 224 -116.332	5	4.8		041 155	E.	106
ERL	1973	06 21	144459.60	37 084 -115.993	5	5.3		041 018		134

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	VALUES	F-E STA REG	*****INFORMATION***** ITEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
ERL	1973	06 24 113732.80*	37.754 -116.153	5 G		4.2		041 007	.....	145
ERL	1973	06 28 191512.40A	37.148 -116.086	0		4.9	5.20MLBRK	041 066	.....	126
GS	1973	09 11 023948.20	37.641 -118.889	11		4.2	3.90MLPAS	040 011	.....E..	142
CDMG	1973	09 15 010315.40P	36.602 -119.375	8			4.40MLPAS	039 B	5.....P.	172
CDMG	1973	10 07 173053.40P	37.593 -118.982	8			4.00MLPAS	040 B	.....P.	146
GS	1973	10 12 170000.80A	37.200 -116.203	0		4.8	4.60UKBRK	041 053	.....E..	117
GS	1973	10 17 153427.40B	37.600 -118.980	2		4.2	3.90MLBRK	040 012	.....	147
GS	1973	11 28 153000.50	36.937 -116.033	5 G		4.4	4.40MLBRK	040 015	.....	130
GS	1973	12 12 190000.50	36.947 -116.020	5 G		4.5	4.40MLBRK	040 023	.....	131
CDMG	1974	01 02 134955.90P	35.551 -117.264	6			4.20MLPAS	039 B	.....P.	162
GS	1974	02 27 170000.10A	37.104 -116.053	0		5.8	5.00MLPAS	041 175	.....E..	129
GS	1974	05 22 141500.50	37.056 -116.107	5 G		4.4	4.30MLBRK	041 19	.....	124
GS	1974	05 23 133830.20	37.064 -116.072	5 G		4.8	4.80MLBRK	041 49	.....	127
GS	1974	05 29 181039.90	36.818 -115.870	5 G			4.00MLPAS	040 13	.....	146
GS	1974	05 29 192332.80	36.817 -115.881	11			4.00MLPAS	040 15	3F.....	145
GS	1974	06 06 144000.00	37.002 -116.942	2		4.4		041 15	.....	129
GS	1974	06 09 222733.70P	35.533 -117.450	8			4.00MLPAS	039 18	3F.....	162
CDMG	1974	06 10 064410.00P	35.536 -117.440	9			4.10MLPAS	039 B	5.....P.	162
GS	1974	06 19 155959.90	37.198 -116.188	5 G		5.0		041 58	.....	138
GS	1974	07 18 140001.30	37.067 -116.066	5 G		5.7	5.60MLBRK	041 144	.....E..	110
GS	1974	07 31 073127.30*	35.699 -117.608	10 G		4.1	4.20MLBRK	041 12	.....	127
GS	1974	08 14 140000.10A	37.023 -116.036	0			4.00MLPAS	039 9	.....	144
GS	1974	08 25 101059.30	35.886 -117.663	10 G		4.6	4.30MLBRK	041 18	.....E..	130
GS	1974	08 30 150000.20A	37.150 -116.083	0		4.1	4.00MLPAS	039 11	.....	124
GS	1974	09 25 140000.30	36.973 -116.002	5 G		5.8	5.80MLBRK	041 160	.....E..	127
GS	1974	09 26 150500.20A	37.133 -116.068	0		4.4		040 17	.....	133
CDMG	1974	11 14 162041.10P	37.735 -117.994	8		5.6	5.00MLBRK	041 146	.....E..	128
GS	1974	12 16 173000.50	36.889 -115.980	5 G		4.3	4.00MLPAS	040 D	.....P.	92
GS	1975	01 19 142850.40P	36.267 -118.383	2			3.80MLPAS	040 13	.....	135
GS	1975	02 25 111322.40	37.137 -117.851	10 G		4.1	4.00MLBRK	039 17	.....	113
GS	1975	02 28 151500.00A	37.106 -116.056	0		5.7		040 10	.....	34
GS	1975	03 07 150000.00A	37.134 -116.084	0		5.5	5.20MLBRK	041 187	.....	128
GS	1975	04 05 194500.00A	37.188 -116.214	0		4.8	4.50MLBRK	041 117	.....E..	126
GS	1975	04 17 091833.40P	35.767 -118.583	8		3.6	4.00MLPAS	041 69	.....E..	116
GS	1975	04 24 141000.00A	37.116 -116.087	0		4.6	4.40MLBRK	039 19	5F.....	167
GS	1975	05 04 150000.00A	37.109 -116.029	0		5.2		041 34	.....E..	126
GS	1975	05 14 140000.40A	37.221 -116.474	0		6.0	5.80UKBRK	041 102	.....E..	131
GS	1975	06 03 142000.20A	37.340 -116.523	0		5.9	6.00MLBRK	041 212	.....E..	94
GS	1975	06 03 144000.10A	37.095 -116.036	0		5.7	5.60MLBRK	041 205	.....E..	94
GS	1975	06 19 130000.10A	37.350 -116.320	0		6.1	5.90MLBRK	041 185	.....E..	130
GS	1975	06 26 123000.20A	37.279 -116.369	0		6.2	6.10MLBRK	041 218	.....E..	111
GS	1975	06 27 072643.80	37.216 -116.401	5 G		4.6	4.10MLBRK	041 235	.....E..	105
GS	1975	06 28 094733.80	37.287 -116.455	5 G		4.4	4.20MLBRK	041 8	.....	100
GS	1975	07 01 045031.90	37.281 -116.355	5 G		4.5	4.20MLBRK	041 6	.....	98
GS	1975	07 01 181408.80	37.216 -116.427	5 G		4.7	4.80MLBRK	041 20	.....	106
GS	1975	08 17 002426.00	37.609 -118.814	5 G			4.00MLBRK	041 14	.....	98
GS	1975	09 06 170000.10A	37.024 -116.028	0		4.6	4.30MLBRK	040 14	.....	134
GS	1975	10 24 171126.10A	37.222 -116.179	0		4.7	4.70MLBRK	041 42	.....E..	130
GS	1975	10 28 143000.20A	37.290 -116.411	0		6.4	6.20MLBRK	041 53	.....E..	119
							6.30MLPAS	041 241	.....E..	101

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	**COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms OBS CONTRIBUTED VALUES	F-E STA REG	***INFORMATION*** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1975	11 03 021947.00	37.290 -116.411	0		4.5	041 30	.....	101
GS	1975	11 18 153000.30	36.991 -116.032	5 G		4.4	041 18	.....	130
GS	1975	11 20 150000.10A	37.225 -116.368	0		6.0	041 172	.....	103
GS	1975	11 26 153000.20A	37.117 -116.019	0		5.0	041 20	.....	132
GS	1975	12 20 200000.20A	37.128 -116.062	0		5.7	041 180	.....	128
GS	1976	01 03 191500.20A	37.297 -116.333	0		6.2	041 146	.....	108
GS	1976	01 04 011818.30	37.294 -116.366	5 G		4.1	041 17	.....	105
GS	1976	01 04 161609.00	37.297 -116.333	5 G		4.2	041 14	.....	108
GS	1976	01 08 161419.90*	37.306 -116.358	5 G		4.5	041 9	.....	106
GS	1976	01 17 213933.40	37.281 -116.405	5 G			041 9	.....	102
GS	1976	01 18 072017.90	37.309 -116.433	5 G		4.4	041 14	.....	100
GS	1976	02 03 001428.40	37.331 -116.362	5 G			041 9	.....	107
GS	1976	02 04 142000.10A	37.069 -116.030	0		5.8	041 106	.....	130
GS	1976	02 04 144000.20A	37.107 -116.037	0		5.7	041 195	.....	130
GS	1976	02 06 011424.20	37.319 -116.367	5 G			041 12	.....	106
GS	1976	02 07 073655.60	37.249 -116.388	5 G		4.3	041 27	.....	102
GS	1976	02 12 144500.20A	37.271 -116.488	0		6.3	041 285	.....	94
GS	1976	02 12 173729.00	37.271 -116.488	0		4.8	041 17	.....	94
GS	1976	02 14 113000.20A	37.243 -116.420	0		6.0	041 168	.....	99
GS	1976	02 17 231817.60*	37.311 -116.484	5 G		4.0	041 11	.....	96
GS	1976	02 26 144959.90	37.014 -115.971	5 G		4.2	041 14	.....	136
GS	1976	03 09 140000.10A	37.310 -116.364	0		6.0	041 240	.....	106
GS	1976	03 09 165502.00	37.310 -116.364	0		4.1	041 13	.....	106
GS	1976	03 09 205407.20	37.321 -116.293	5 G		4.1	041 12	.....	112
GS	1976	03 14 123000.20A	37.306 -116.471	0		6.3	041 298	.....	97
GS	1976	03 14 140952.00	37.306 -116.471	0		4.3	041 14	.....	97
GS	1976	03 14 141815.00	37.306 -116.471	0		4.2	041 16	.....	97
GS	1976	03 14 145922.20	37.306 -116.471	0		4.3	041 11	.....	97
GS	1976	03 14 152428.80	37.306 -116.471	0		4.1	041 21	.....	97
GS	1976	03 17 141500.10A	37.256 -116.312	0		6.1	041 241	.....	109
GS	1976	03 17 144500.10A	37.107 -116.052	0		5.8	041 217	.....	129
GS	1976	03 19 081703.20*	37.196 -116.577	5 G		4.1	041 9	.....	84
GS	1976	03 20 062304.90*	37.354 -116.688	5 G		4.0	041 7	.....	82
GS	1976	03 23 024806.10*	37.326 -116.464	5 G		4.9	041 5	.....	98
GS	1976	05 12 195000.20A	37.209 -116.212	5 G			041 78	.....	116
GS	1976	06 07 003238.60	36.577 -116.366	5 G		4.0	040 15	.....	111
GS	1976	06 07 003713.10	36.604 -116.328	5 G			040 16	.....	113
GS	1976	07 27 203000.10A	37.075 -116.044	0		5.3	041 121	.....	129
GS	1976	08 02 081407.40	38.381 -118.185	8		4.8	040 19 4F	.....	164
GS	1976	08 26 143000.20A	37.125 -116.082	0		5.3	041 110	.....	126
GS	1976	12 08 144930.10A	37.079 -116.002	0		4.9	041 44	.....	133
GS	1976	12 21 150900.20A	37.124 -116.067	0			041 31	.....	128
GS	1976	12 28 180000.10A	37.100 -116.036	0		5.5	041 166	.....	130
GS	1976	12 28 202926.00	37.100 -116.036	0		4.4	041 25	.....	130
GS	1977	01 06 075439.00	36.820 -115.877	5 G			040 13	.....	145
GS	1977	02 16 175300.20	36.999 -116.036	5 G		4.8	041 35	.....	130
GS	1977	04 05 150000.20A	37.120 -116.062	0		5.6	041 221	.....	128
GS	1977	04 05 165706.30	37.120 -116.062	0		4.6	041 26	.....	128

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1977	04 27	150000.10A							
GS	1977	05 25	170000.10A	0		5.4	4.2Z	041 183	5.10MLBRK	131
GS	1977	08 04	164000.10A	0		5.3		041 180	5.20MLBRK	129
GS	1977	08 08	045141.50B	0		5.0	5.7Z	041 139	5.00MLBRK	133
GS	1977	08 16	154900.20	2				040 29	4.00MLBRK	66
GS	1977	08 19	175000.10A	5	G			041 14	4.00MLBRK	129
GS	1977	08 19	175000.10A	0				041 188	5.50MLBRK	129
GS	1977	09 15	143630.10A	0		5.6		041 28	4.10MLBRK	129
GS	1977	09 27	140000.20A	0		4.5		041 82	4.80MLBRK	128
GS	1977	10 10	192604.90B	6		4.8		040 24	4.00MLBRK	158
GS	1977	10 26	141500.10A	0				041 35	4.50MLBRK	131
GS	1977	11 01	180600.10A	0		4.4		041 16	4.10MLBRK	116
GS	1977	11 09	220000.10A	0		4.7	4.0Z	041 216	5.60MLBRK	129
GS	1977	11 17	193000.10A	0		5.7		041 34	4.40MLBRK	131
GS	1977	12 14	153000.20A	0		4.7		041 193	5.60MLBRK	126
GS	1978	02 13	215259.60	2	G	3.8		041 15	4.00MLBRK	134
GS	1978	02 23	170000.20A	0		5.6		041 218	5.40MLBRK	128
GS	1978	03 16	145959.60	2	G	3.9		041 16	4.40MLBRK	128
GS	1978	03 23	163000.20A	0		5.6		041 219	5.50MLBRK	129
GS	1978	04 11	153000.20A	0		5.3		041 198	5.30MLBRK	109
GS	1978	04 11	174500.10A	0		5.5	4.5Z	041 191	5.30MLBRK	103
GS	1978	07 07	135959.30	2	G	4.0		041 26	4.30MLBRK	132
GS	1978	07 12	170000.10A	0		5.5	4.1Z	041 211	5.40MLBRK	129
GS	1978	08 31	140000.20A	0		5.6		041 185	5.50MLBRK	105
GS	1978	09 13	151500.20A	0		4.6		041 67	4.60MLBRK	116
GS	1978	09 27	170000.00A	0		5.0		041 97	5.00MLBRK	129
GS	1978	09 27	172000.00A	0		5.7	4.1Z	041 233	5.50MLBRK	131
GS	1978	10 04	164248.60P	9		5.4	5.1Z	040 161	5.80MLBRK	116
GS	1978	10 04	165904.60P	12				040 23	5.80MLPAS	116
GS	1978	10 04	173131.10P	10				040 26	4.40MLPAS	114
GS	1978	10 04	173902.90P	10		5.0		040 43	4.30MLPAS	118
GS	1978	10 04	174647.50P	8				040 12	5.30MLPAS	115
GS	1978	10 04	180153.30P	8				040 12	4.20MLPAS	117
GS	1978	10 04	182241.60P	9				040 19	3.90MLPAS	114
GS	1978	10 05	011747.30P	6		4.1		040 36	4.40MLPAS	115
GS	1978	10 05	064130.10P	8				040 27	4.40MLPAS	113
GS	1978	11 02	152500.20A	0		4.2		041 33	4.50MLPAS	111
GS	1978	11 18	190000.00A	0		5.1		041 162	4.30MLBRK	126
GS	1978	12 16	153000.20A	0		5.5		041 218	5.20MLBRK	101
GS	1979	01 19	181040.80B	5				040 25	5.50MLBRK	123
GS	1979	01 24	180000.10A	0		4.5		041 31	4.20MLPAS	132

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	P P STN DEV	*****M A G N I T U D E S**** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	****INFORMATION**** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1979	01 24	211425.90B	5				040	32 4F.....	114
GS	1979	02 08	200000.10A							
GS	1979	02 15	180500.20A	0		5.5	4.1Z	041	192.....	124
GS	1979	03 14	183000.10A	0		4.8		041	73.....	124
GS	1979	05 11	155959.70	2		4.3		041	27.....	124
GS	1979	06 08	054403.60	5				041	39.....	132
GS	1979	06 11	140000.20E	0				037	11 5F.....	176
GS	1979	06 14	073927.90P	5		5.5	4.4Z	041	190.....	96
GS	1979	06 16	224458.40B	2		4.2		039	33 6D.....	145
GS	1979	06 20	150013.50E							
GS	1979	06 28	144400.20E	0		4.0		041	25.....	132
GS	1979	08 03	150730.20A	0		5.0		041	121.....	126
GS	1979	08 08	150000.10A	0		4.5		041	73.....	127
GS	1979	08 29	150800.20A	0		4.8		041	59.....	132
GS	1979	09 06	150000.10A	0		4.7		041	75.....	128
GS	1979	09 07	094347.30B	3		5.8	4.1Z	041	211.....	129
GS	1979	09 24	130503.20B	5				040	22 5F.....	143
GS	1979	09 26	150000.10A							
GS	1979	11 09	101253.30B	5		5.6	4.1Z	041	188.....	104
GS	1979	11 09	174656.70B	5				040	23 .F.....	141
GS	1979	11 20	172357.10B	5				040	14 .F.....	141
GS	1979	11 20	175413.50B	5				040	10 4F.....	139
GS	1979	12 06	193236.80B	5				039	17 .F.....	148
GS	1979	12 08	213850.40B	5				040	15 .F.....	145
GS	1979	12 25	141710.80	5				040	13 .F.....	143
GS	1979	12 25	080904.80B	5				040	14 .F.....	147
GS	1979	12 31	082751.90B	5				040	22.....	49
GS	1979	01 14	235152.50B	5				040	17 .F.....	136
GS	1979	02 22	023041.30	5		4.2		040	41 5F.....	174
GS	1980	02 28	150000.10B	0				040	22 .F.....	138
GS	1980	03 08	153500.10A	0				040	16 .F.....	117
GS	1980	03 20	110542.90B	22				041	21.....	126
GS	1980	03 20	110542.90B	22		4.4		041	23.....	127
GS	1980	03 20	110542.90B	22		3.9		040	17 .F.....	143

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** IEMFDIPIF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1980	03 27	022604.30B	37.623 -118.908	4		040	24 4F.....	142
GS	1980	04 03	140000.10A	37.150 -116.082	0		041	80.....	127
GS	1980	04 16	200000.10A	37.101 -116.031	0	4.7	041	165.....E.....	131
GS	1980	04 26	170000.10A	37.248 -116.422	0	5.3	041	208.....E.....	99
GS	1980	05 02	184630.10A	37.056 -116.019	0	5.4	041	35.....E.....	131
GS	1980	05 17	000114.40B	37.608 -118.838	18	4.4	040	22 .F.....	136
GS	1980	05 18	124730.10B	37.608 -118.880	12		040	19 .F.....	139
GS	1980	05 25	163344.70B	37.600 -118.840	5	6.1	040	246 7CU.....	136
GS	1980	05 25	164157.30P	37.533 -118.833	4		040	3.....	132
GS	1980	05 25	164528.90P	37.483 -118.800	5		040	3.....	127
GS	1980	05 25	164927.30B	37.609 -118.875	24	5.5	040	105 .F.....	139
GS	1980	05 25	165228.50P	37.649 -118.733	5		040	2.....	130
GS	1980	05 25	165613.10P	37.633 -118.900	5		040	3.....	142
GS	1980	05 25	165949.70P	37.567 -118.833	4		040	2.....	133
GS	1980	05 25	170624.20B	37.527 -118.832	12		040	12 .F.....	131
GS	1980	05 25	170828.90B	37.609 -118.877	20	4.2	040	8 .F.....	139
GS	1980	05 25	174830.70B	37.527 -118.832	12	3.9	040	9 .F.....	131
GS	1980	05 25	181358.50P	37.550 -118.817	1		040	4.....	131
GS	1980	05 25	183415.30B	37.542 -118.885	10	4.1	040	10 .F.....	136
GS	1980	05 25	190434.50B	37.558 -118.910	5		040	4 .F.....	139
GS	1980	05 25	194125.40P	37.516 -118.800	5		040	4.....	128
GS	1980	05 25	194451.40B	37.569 -118.820	15	5.5	040	198 7CU.....	132
GS	1980	05 25	195152.70P	37.533 -118.883	5		040	3.....	136
GS	1980	05 25	195500.80P	37.533 -118.767	5		040	3.....	126
GS	1980	05 25	202327.10P	37.616 -118.817	3		040	5.....	135
GS	1980	05 25	203548.50B	37.634 -118.873	12	5.2	040	113 .F.....	140
GS	1980	05 25	203841.60P	37.567 -118.683	4		040	3.....	122
GS	1980	05 25	205923.30B	37.591 -118.827	10	4.2	040	24 .F.....	134
GS	1980	05 25	221036.40P	37.432 -118.767	5		040	5.....	122
GS	1980	05 26	005705.10P	37.549 -118.800	5	4.2	040	25.....	130
GS	1980	05 26	011901.90B	37.616 -118.868	10	4.4	040	30 .F.....	139
GS	1980	05 26	034908.00P	37.633 -118.717	1		040	4.....	128
GS	1980	05 26	043654.80P	37.649 -118.700	3		040	5.....	128
GS	1980	05 26	055627.00B	37.587 -118.897	10	4.0	040	17 .F.....	139
GS	1980	05 26	064348.60P	37.450 -118.850	4		040	2.....	129

CATALOG SOURCE	DATE YEAR MO DA	ORIGIN TIME	***COORDINATES*** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** ITEMFMDIPL PHENOMENA NFAOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1980	05 26	102031.50B	37.627 -118.817	2	4.0	040 15	.F.	135
GS	1980	05 26	110406.70P	37.499 -118.700	5		040 6		119
GS	1980	05 26	122425.40B	37.577 -118.897	2	4.7	040 54	.F.	139
GS	1980	05 26	130420.60P	37.499 -118.817	2		040 4		129
GS	1980	05 26	143732.40P	37.483 -118.817	1	4.1	040 8		128
GS	1980	05 26	162021.60B	37.549 -118.867	10	4.7	040 57	.F.	135
GS	1980	05 26	185756.30B	37.560 -118.895	6	5.0	040 77	.F.	138
GS	1980	05 26	192409.90B	37.533 -118.892	6		040 11	.F.	136
GS	1980	05 27	090931.30P	37.600 -118.850	2		040 8		136
GS	1980	05 27	145057.10B	37.475 -118.812	13	5.7	040 233	6CU.	127
GS	1980	05 27	154146.90P	37.483 -118.817	1		040 5		128
GS	1980	05 27	170958.60P	37.483 -118.817	6		040 11		128
GS	1980	05 27	190108.60B	37.602 -118.807	11	4.3	040 24	.F.	133
GS	1980	05 27	213454.30P	37.499 -118.817	5		040 11		129
GS	1980	05 27	234103.90P	37.567 -118.850	5		040 10		135
GS	1980	05 28	051623.90B	37.588 -118.910	10	4.1	040 32	.F.	140
GS	1980	05 28	054830.50B	37.597 -118.902	5	4.0	040 22	.F.	140
GS	1980	05 28	115437.90P	37.467 -118.817	6		040 12		127
GS	1980	05 29	172101.30P	37.516 -118.833	4		040 12		131
GS	1980	05 31	005818.00B	37.517 -118.862	11	4.1	040 16	.F.	133
GS	1980	05 31	080519.70B	37.575 -118.847	10		040 13		135
GS	1980	05 31	101131.20B	37.589 -118.840	5		040 15		135
GS	1980	05 31	151612.00B	37.607 -118.802	8	4.1	040 39	.F.	133
GS	1980	06 01	064736.80B	37.495 -118.862	12	3.7	040 16		132
GS	1980	06 02	102221.20B	37.593 -118.935	5		040 14		143
GS	1980	06 05	194102.00B	37.572 -118.900	3		040 10	.F.	139
GS	1980	06 07	231753.20B	37.640 -118.887	5		040 14		141
GS	1980	06 08	232221.30B	37.512 -118.853	20		040 12		132
GS	1980	06 11	044059.00B	37.560 -118.897	6	3.9	040 22	5F.	138
GS	1980	06 12	171500.10A	37.282 -116.454	0	5.6	041 201		98
GS	1980	06 13	145659.30B	37.617 -118.905	5		040 13		142

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** 1EMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1980	06 13	232320.30B	37.510 -118.825	14	|	|	040 13	.....	130
GS	1980	06 24	151000.10A	37.023 -116.034	0	|	|	041 26	.....	130
GS	1980	06 28	005842.70B	37.583 -118.832	5	|	|	040 11	.....	134
GS	1980	06 29	074614.10B	37.975 -118.670	15	|	|	040 31	6D.....	149
GS	1980	06 30	102301.50B	38.005 -118.707	5	|	|	040 12	.....	154
GS	1980	07 03	021932.00B	37.630 -118.923	5	|	|	040 23	.....	144
GS	1980	07 03	023958.80B	37.558 -118.908	11	|	|	040 20	.....	139
GS	1980	07 05	115859.20B	37.610 -118.833	5	|	|	040 21	F.....	136
GS	1980	07 25	190500.10A	37.256 -116.477	0	|	|	041 178	.....	95
GS	1980	07 31	181900.10A	37.013 -116.023	0	|	|	041 23	.....	131
GS	1980	08 01	163856.30B	37.560 -118.893	4	|	|	040 110	5FU.....	138
GS	1980	08 01	164854.90B	37.555 -118.903	5	|	|	040 23	.....	138
GS	1980	08 01	170917.50B	37.578 -118.880	8	|	|	040 11	.....	138
GS	1980	08 19	064527.20B	37.625 -118.867	5	|	|	040 18	F.....	139
GS	1980	09 04	133909.50B	38.089 -118.572	5	|	|	040 29	5F.....	153
GS	1980	09 04	210333.90B	38.057 -118.518	20	|	|	040 36	F.....	147
GS	1980	09 06	053103.30B	38.075 -118.577	5	|	|	040 15	.....	152
GS	1980	09 06	072752.10B	38.068 -118.572	5	|	|	040 23	.....	151
GS	1980	09 07	013042.70B	38.048 -118.558	14	|	|	040 50	F.....	149
GS	1980	09 07	043638.30B	38.033 -118.578	15	|	|	040 104	5F.....	149
GS	1980	09 07	064810.50B	38.077 -118.603	5	|	|	040 17	.....	154
GS	1980	09 07	064830.20B	38.078 -118.603	5	|	|	040 44	F.....	154
GS	1980	09 08	042619.90B	38.028 -118.582	13	|	|	040 18	F.....	148
GS	1980	09 16	042441.10B	38.012 -118.557	14	|	|	040 20	F.....	146
GS	1980	09 25	144500.10A	37.056 -116.048	0	|	|	041 27	.....	129
GS	1980	09 27	191624.90B	37.620 -118.903	5			040 14	F.....	142
GS	1980	10 04	163822.60B	37.533 -118.853	4			040 20	F.....	133

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CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S**** mb OBS Ms	VALUES	F-E STA REG	*****INFORMATION***** NFAOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1981	09 30	130548.50B	5 G		4.7 10	4.60MLPAS 4.80MLBRK	040 55 5F	.....	140
GS	1981	09 30	145006.80B	3 G			4.10MLPAS 4.30MLBRK	040 17 F	.....	142
GS	1981	09 30	193512.30B	8 G			3.60MLPAS 4.00MLBRK	040 11 F	.....	133
GS	1981	10 01	070205.10B	7 G		3.9 2	4.60MLBRK 5.20MLPAS	040 28 F	.....	136
GS	1981	10 01	190000.10E	0 G		4.9 36	5.00MLBRK 4.20MLBRK	041 91	.....E..	132
GS	1981	10 02	073722.30B	4 G			4.00MLBRK 4.00MLBRK	040 11 F	.....	140
GS	1981	10 03	012037.30B	1 G			5.00MLBRK 5.00MLBRK	040 11 F	.....	136
GS	1981	11 11	200000.04E	0 G		4.8 27	4.80MLBRK 4.80MLBRK	041 85	.....E..	127
GS	1981	11 12	150000.10E	0 G		5.3 68	5.30MLPAS 5.50MLBRK	041 160	.....E..	129
GS	1981	12 03	150000.10E	0 G		4.6 8	4.90MLBRK 4.00MLBRK	041 47	.....E..	128
GS	1981	12 15	080533.90P	4 G			3.80MLPAS 4.40MLBRK	040 18 4F	.....	104
GS	1981	12 16	210500.09E	0 G		4.4 4	4.40MLBRK 4.10MLPAS	041 33	.....E..	123
GS	1982	01 24	154407.60B	5 G			4.30MLBRK 5.80MLPAS	040 23 3F	.....	57
GS	1982	01 28	160000.10E	0 G		5.9 84	5.80MLPAS 5.60MLBRK	041 244	.....E..	129
GS	1982	02 12	145500.08E	0 G		5.4 58	5.40MLBRK 5.50MLBRK	041 133	.....E..	95
GS	1982	02 12	152500.09E	0 G		5.6 78	4.40MLBRK 4.10MLPAS	041 161	.....E..	111
GS	1982	03 01	031022.30P	4 G		4.1 2	4.40MLBRK 4.00MLBRK	039 32 5F	.....	136
GS	1982	03 01	060923.60P	6 G			3.40MLPAS 4.90MLBRK	039 13 F	.....	138
GS	1982	03 07	205012.80P	2 G		4.3 4	4.30MLPAS 5.00MLBRK	039 38 5F	.....	138
GS	1982	03 07	205100.00P	2 G		4.7 1	4.50MLPAS 4.20MLBRK	039 9 F	.....	140
GS	1982	03 08	144246.00P	4 G			3.90MLPAS 5.10MLBRK	039 25	.....	140
GS	1982	04 15	215208.60B	20 G		4.5 5	4.40MLBRK 4.30MLBRK	040 48 4F	.....	144
GS	1982	04 17	180000.09E	0 G		4.5 4	3.70MLPAS 5.40MLBRK	041 29	.....E..	132
GS	1982	04 25	041326.00P	5 G		3.7 1	4.20MLBRK 4.20MLBRK	039 16	.....	138
GS	1982	04 25	180500.08E	0 G		5.4 77	3.80MLPAS 5.60MLPAS	041 185	.....E..	99
GS	1982	04 27	154240.20P	5 G			5.60MLBRK 5.60MLBRK	039 19 4F	.....	138
GS	1982	05 06	200000.08E	0 G		4.3 1	4.60MLBRK 5.60MLBRK	041 18	.....E..	122
GS	1982	05 07	181700.11E	0 G		5.7 76	4.40MLBRK 4.30MLBRK	041 228	.....E..	129
GS	1982	06 04	164148.30B	26 G			4.30MLBRK 4.30MLBRK	040 15 4F	.....	93
GS	1982	06 16	140000.85E	0 G			5.70MLPAS 5.60MLBRK	041 21	.....E..	132
GS	1982	06 24	141500.09E	0 G		5.6 74	4.60MLBRK 4.60MLBRK	041 209	.....E..	103
GS	1982	07 29	200500.08E	0 G		4.5 3	4.60MLBRK	041 32	.....E..	127

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1982	08 05	140000.09E	37.084 -116.007	0 G	5.7	93|4.22	041 227	..... E..	133
GS	1982	08 26	193908.40B	37.597 -118.855	10 G	|	|	040 17	F.....	137
GS	1982	08 29	210804.00B	38.165 -118.432	5 G	|	|	040 16	F.....	153
GS	1982	09 23	032800.40B	37.477 -118.850	10 G	|	|	040 16	F.....	130
GS	1982	09 23	160000.09E	37.212 -116.207	0 G	4.9	33|	041 92	..... E..	117
GS	1982	09 23	170000.08E	37.175 -116.088	0 G	4.9	28|	041 74	..... E..	126
GS	1982	09 24	074024.30B	37.852 -118.123	5 G	5.0	16|4.62	040 79	5F.....	109
GS	1982	09 28	004149.10	37.485 -118.797	5 G	0.70|	|	040 13	F.....	126
GS	1982	09 29	133000.10E	37.091 -116.045	0 G	|	|	041 15	..... E..	129
GS	1982	09 29	182101.10P	35.750 -117.750	8 G	|	|	039 8	4F.....	140
GS	1982	09 30	223810.60P	35.750 -117.750	8 G	4.4	1|	039 25	4F.....	140
GS	1982	10 01	013335.15	37.926 -118.174	5 G	1.03|	|	040 17	.....	118
GS	1982	10 01	142904.60P	35.733 -117.750	8 G	4.9	11|	039 72	6D.....	142
GS	1982	10 01	171442.10P	35.750 -117.750	8 G	|	|	039 18	.....	140
GS	1982	10 01	204555.40P	35.750 -117.733	6 G	|	|	039 22	.....	140
GS	1982	10 01	221021.90P	35.717 -117.767	7 G	4.5	4|	039 37	.....	144
GS	1982	10 01	221128.80P	35.717 -117.767	7 G	4.3	1|	039 4	.....	144
GS	1982	10 02	093305.90B	37.872 -118.285	5 G	|	|	040 20	.....	119
GS	1982	10 04	022359.00B	37.862 -118.088	5 G	|	|	040 16	.....	108
GS	1982	10 04	184328.50P	35.750 -117.767	8 G	|	|	039 21	.....	140
GS	1982	10 14	193450.20B	37.503 -118.835	5 G	|	|	040 17	F.....	130
GS	1982	11 12	191700.10E	37.024 -116.032	0 G	4.4	2|	041 27	..... E..	130
GS	1982	12 10	152000.09E	37.030 -116.072	0 G	4.6	7|	041 39	..... E..	127
GS	1982	12 28	190624.00B	38.030 -118.350	18 G	4.7	19|	040 67	4F.....	136
GS	1982	12 31	090723.30P	35.817 -117.733	6 G	4.4	1|	039 29	4F.....	132
GS	1983	01 04	030305.00P	35.800 -117.750	7 G	4.3	1|	039 23	F.....	134
GS	1983	01 07	013126.00B	37.638 -118.933	21 G	|	|	040 17	F.....	145
GS	1983	01 07	013646.80B	37.637 -118.905	10 G	4.1	1|	040 13	F.....	143
GS	1983	01 07	013811.00B	37.628 -118.915	14 G	5.1	30|5.02	040 89	6DU.....	143
GS	1983	01 07	032419.40B	37.618 -118.977	12 G	5.1	34|5.02	040 123	6DU.....	147
GS	1983	01 07	033023.30B	37.635 -118.975	10 G	|	|	040 13	F.....	148

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.		DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms		OBS VALUES	F-E STA REG	*****INFORMATION***** IEMFWDIFL PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG				RADIAL DIST km
GS	1983	01 07 063825.60B	37.648	-118.970	7 G					040 19	.F.....				148
GS	1983	01 25 101040.90B	37.517	-118.880	9 G		4.4	2		040 32	.F.....				135
GS	1983	01 29 150601.30B	37.627	-118.933	10 G					040 13	.F.....				144
GS	1983	01 31 101341.30B	37.517	-118.887	8 G					040 11	.F.....				135
GS	1983	02 04 071510.10B	37.660	-118.933	10 G		3.9	1		040 19	.F.....				146
GS	1983	02 11 160000.10E	37.051	-116.045	0 G					041 19				E..	129
GS	1983	02 17 170000.09E	37.163	-116.063	0 G		4.0	1		041 20				E..	128
GS	1983	03 01 014916.50P	35.817	-117.717	6 G					039 13					132
GS	1983	03 16 152528.40B	37.560	-118.910	10 G					040 21	.F.....				139
GS	1983	03 26 202000.07E	37.301	-116.460	0 G		5.1	35		041 135				E..	98
GS	1983	04 14 190500.12E	37.073	-116.046	0 G		5.7	73		041 227				E..	129
GS	1983	04 22 135300.08E	37.112	-116.022	0 G		4.0	1		041 16				E..	131
GS	1983	05 05 152000.08E	37.012	-116.089	0 G		4.5	6		041 29				E..	125
GS	1983	05 26 150000.09E	37.103	-116.006	0 G		4.4	4		041 40				E..	133
GS	1983	06 09 171000.09E	37.158	-116.089	0 G		4.5	13		041 43				E..	126
GS	1983	07 03 184008.20B	37.535	-118.858	8 G		4.8	22		040 95	5F.....				134
GS	1983	07 12 183906.00B	37.528	-118.873	9 G					040 18	.F.....				135
GS	1983	07 30 012616.70B	37.582	-118.772	4 G					040 15	.F.....				129
GS	1983	08 03 133300.10E	37.119	-116.089	0 G		4.2	1		041 27				E..	126
GS	1983	08 11 140000.12E	36.998	-116.003	0 G		4.4	1		040 24				E..	133
GS	1983	08 27 135959.98*	37.192	-115.992	5 G		0.99	4.1	1	041 20					135
GS	1983	09 01 140000.08E	37.273	-116.355	0 G		5.4	56		041 171				E..	106
GS	1983	09 21 150000.09E	37.210	-116.209	0 G					041 23				E..	117
GS	1983	09 21 162459.72	37.113	-116.043	2		0.66			041 20					130
GS	1983	09 22 150000.12E	37.106	-116.049	0 G					041 24				E..	129
GS	1983	09 30 161400.80B	37.545	-118.835	9 G					040 18	4F.....				132
GS	1983	10 19 140037.42*	35.905	-118.332	5 G		0.44			039 15					142
GS	1983	10 21 224413.46	35.894	-118.329	5 G		1.15	4.4	5	039 29	3F.....				143
GS	1983	10 24 233649.72	35.907	-118.316	5 G		0.35	4.1	1	039 14					141
GS	1983	10 25 111657.08	35.821	-118.349	5 G		0.43			039 17					151
GS	1983	11 07 123243.80P	35.930	-118.320	0 G					039 19	.F.....				139
GS	1983	12 07 221556.50B	38.027	-118.738	10 G					040 13					157
GS	1983	12 09 155959.23	37.021	-115.975	2 G		0.56			041 22					135
GS	1983	12 16 183000.09E	37.140	-116.072	0 G					041 107				E..	127
GS	1983	12 31 223940.10B	37.538	-118.902	6 G		5.1	30		040 16	.F.....				137

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** OBS Ms	OBS mb	F-E STA REG	*****INFORMATION***** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1984	01 14	004224.20B	37.458 -118.613	6 G			040 18	F.....	111
GS	1984	01 14	031115.20B	37.417 -118.597	9 G			040 18	F.....	107
GS	1984	01 31	153000.08E	37.113 -116.122	0 G		4.1	041 27	.....E.....	123
GS	1984	02 05	105846.20B	37.658 -119.023	10 G			039 20	.....	153
GS	1984	02 15	170000.10E	37.221 -116.181	0 G		5.0	041 120	.....E.....	119
GS	1984	02 27	013621.10B	37.383 -118.603	7 G		4.3	040 30	3F.....	106
GS	1984	03 01	174500.09E	37.066 -116.046	0 G		5.9	041 247	.....E.....	129
GS	1984	03 23	075321.70P	35.980 -118.320	0 G			039 23	.....	134
GS	1984	03 23	080759.30P	35.970 -118.320	0 G			039 20	.....	135
GS	1984	03 23	082425.30P	35.980 -118.320	0 G			039 15	.....	134
GS	1984	03 31	143000.08E	37.146 -116.084	0 G		4.1	041 32	.....E.....	126
GS	1984	04 28	224821.00B	37.622 -118.897	3 G		4.3	040 27	4F.....	141
GS	1984	05 01	190500.09E	37.106 -116.022	0 G		5.3	041 171	.....E.....	131
GS	1984	05 01	200648.04*	37.085 -115.966	0 G		0.78	041 15	.....E.....	136
GS	1984	05 31	130400.10E	37.103 -116.048	0 G		5.8	041 239	.....E.....	129
GS	1984	06 20	151500.09E	37.000 -116.043	0 G		4.6	041 52	.....E.....	129
GS	1984	06 20	161000.49	37.002 -116.031	0 G		1.02	041 18	.....E.....	130
GS	1984	07 06	120012.70P	35.730 -118.050	8 G			039 19	3F.....	149
GS	1984	07 06	221414.00P	35.730 -118.050	7 G			039 14	F.....	149
GS	1984	07 16	101422.40B	37.625 -118.960	7 G			040 15	3F.....	146
GS	1984	07 25	153000.08E	37.268 -116.411	0 G		5.3	041 179	.....E.....	101
GS	1984	08 02	150000.09E	37.017 -116.008	0 G		4.7	041 47	.....E.....	132
GS	1984	08 19	022234.27	38.356 -118.062	5 G		0.72	040 24	5F.....	158
GS	1984	08 30	144500.10E	37.090 -115.998	0 G		4.5	041 73	.....E.....	133
GS	1984	09 07	145151.20P	35.980 -117.330	0 G			039 20	.....	114
GS	1984	09 13	140000.00E	37.087 -116.071	0 G		5.0	041 117	.....E.....	127
GS	1984	09 13	210136.70?	37.073 -116.097	0 G		0.92	041 5	.....E.....	125
GS	1984	10 02	181359.39	37.076 -115.989	2 G		0.73	041 34	.....	134
GS	1984	11 10	164000.09E	37.000 -116.017	0 G		4.5	041 35	.....E.....	131
GS	1984	11 23	180825.30B	37.480 -118.655	15 G		5.6	040 215	5FU.G.....	115
GS	1984	11 23	191234.50G	37.435 -118.641	0 G		4.8	040 91	F.....	112
GS	1984	11 24	092117.76G	37.489 -118.626	3 G			040 37	F.....	113
GS	1984	11 24	202533.26G	37.458 -118.663	5 G		4.0	040 34	F.....	114

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.		DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms OBS CONTRIBUTED VALUES		F-E STA REG	***INFORMATION*** IEMFMDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG				RADIAL DIST km
GS	1984	11 25	161520.20P&	37.450 -118.690	6 G		|	|	040 34	.....	.....	.....	.....	116
GS	1984	11 25	231009.50P&	37.450 -118.620	6 G		|4.3 11|3.1Z	1	040 53	.....	.....	.....	.....	111
GS	1984	11 26	162147.00B&	37.467 -118.700	10 G		|5.1 49|4.7Z	3	040 128	5C..G....	.....S	.....	.....	118
GS	1984	11 26	163121.40B&	37.445 -118.702	16 G		|	|	040 29	.....	.....	.....	.....	117
GS	1984	11 27	014152.26G&	37.459 -118.680	4 G		|4.0 1|	|	040 39	.....	.....	.....	.....	116
GS	1984	11 27	173123.20P&	37.450 -118.640	6 G		|	|	040 26	.....	.....	.....	.....	112
GS	1984	11 28	064435.42G&	37.428 -118.646	0 G		|	|	040 29	.....	.....	.....	.....	112
GS	1984	11 28	162325.80G&	37.421 -118.671	0 G		|4.3 4|	|	040 41	.....F.....	.....	.....	.....	113
GS	1984	11 28	165738.10B&	37.487 -118.635	18 G		|4.2 3|	|	040 33	.....	.....	.....	.....	114
GS	1984	12 09	194000.09E&	37.270 -116.498	0 G		|5.5 89|4.2Z	2	041 219	.....	E....	.....	.....	93
GS	1984	12 15	144500.00E&	37.281 -116.305	0 G		|5.4 65|	|	041 177	.....	E....	.....	.....	110
GS	1984	12 17	211723.60P&	37.420 -118.620	6 G		|	|	040 28	.....	.....	.....	.....	109
GS	1984	12 20	080306.10B&	37.438 -118.660	10 G		|	|	040 23	.....	.....	.....	.....	113
GS	1984	12 20	161959.76*	36.979 -116.006	2	0.62	|4.2 1|	|	040 22	.....	.....	.....	.....	132
GS	1984	12 24	192229.80P&	37.620 -118.890	6 G		|	|	040 22	3F.....	.....	.....	.....	141
GS	1985	01 03	092149.80P&	37.460 -118.640	6 G		|	|	040 23	.....	.....	.....	.....	113
GS	1985	01 24	112721.70B&	38.140 -118.838	7		|4.3 7|	|	040 57	4F.....	.....	.....	.....	173
GS	1985	03 15	163100.10E&	37.058 -116.045	0 G		|4.8 28|	|	041 99	.....	E....	.....	.....	129
GS	1985	03 18	183231.20P&	37.570 -118.820	6 G		|	|	040 21	.....	.....	.....	.....	132
GS	1985	03 23	183000.08E&	37.180 -116.089	0 G		|5.3 68|	|	041 199	.....	E....	.....	.....	126
GS	1985	03 25	160513.60P&	37.450 -118.540	6 G		|4.9 17|	|	040 91	5F.....	.....	.....	.....	104
GS	1985	04 02	200000.09E&	37.095 -116.032	0		|5.7 87|4.7Z	1	041 267	.....	E....	.....	.....	130
GS	1985	04 02	203912.52*	37.112 -116.063	0 G	1.32	|4.8 1|	|	041 6	.....	I....	.....	.....	128
GS	1985	04 06	231500.09E&	37.201 -116.207	0		|4.8 28|	|	041 97	.....	E....	.....	.....	117
GS	1985	04 26	040307.70P&	37.430 -118.620	6 G		|	|	040 42	3F.....	.....	.....	.....	110
GS	1985	05 02	152000.08E&	37.253 -116.325	0		|5.7 81|	|	041 239	.....	E....	.....	.....	108
GS	1985	05 04	032246.10P&	37.470 -118.600	6 G		|3.7 1|	|	040 37	4F.....	.....	.....	.....	110
GS	1985	06 12	151500.08E&	37.248 -116.489	0		|5.5 67|4.5Z	1	041 220	.....	E....	.....	.....	93
GS	1985	06 12	173000.09E&	37.088 -116.084	0		|4.4 3|	|	041 29	.....	E....	.....	.....	126
GS	1985	06 26	180300.08E&	37.124 -116.122	0		|	|	041 27	.....	E....	.....	.....	123
GS	1985	07 25	140000.09E&	37.297 -116.438	0		|5.2 57|	|	041 183	.....	E....	.....	.....	99
GS	1985	08 16	015121.40P&	36.190 -117.870	5		|4.5 1|	|	040 42	3F.....	.....	.....	.....	95
GS	1985	08 17	162500.09E&	37.002 -116.043	0		|4.6 4|	|	041 29	.....	E....	.....	.....	129

CATALOG SOURCE	D A T E YEAR	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E ***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	****INFORMATION**** ITEMENDIPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1985	08 22 002002.50P&	35.920 -117.720	6 G		|		039 13	.....	121
GS	1985	08 22 002144.00P&	35.920 -117.720	6 G		| 4.3 4|		039 28 4F	.....	121
GS	1985	08 22 031536.56	37.587 -117.395	5 G	0.30|			040 17	.....	65
GS	1985	08 27 030406.80B&	37.412 -118.633	6	|			040 34 3F	.....	110
GS	1985	09 27 141500.09E&	37.090 -116.002	0		| 4.6 16|		041 64	.....E..	133
GS	1985	10 09 232000.09E&	37.210 -116.210	0		| 4.2 2|		041 35	.....E..	116
GS	1985	10 16 213500.09E&	37.110 -116.121	0		| 4.6 12|		041 64	.....E..	123
GS	1985	12 05 150000.07E&	37.053 -116.045	0		| 5.7 89|		041 222	.....E..	129
GS	1985	12 28 190100.09E&	37.238 -116.473	0		| 5.3 57|		041 173	.....E..	94
GS	1986	03 22 161500.08E&	37.083 -116.066	0		| 5.1 49|		041 172	.....E..	127
GS	1986	04 10 140830.10E&	37.218 -116.183	0		| 4.9 43|		041 106	.....E..	119
GS	1986	04 20 231229.92	37.010 -116.027	5 G	0.40|	| 4.0 1|		041 31	.....	131
GS	1986	04 22 143000.09E&	37.264 -116.440	0		| 5.3 56| 4.2Z	1	041 197	.....E..	98
GS	1986	05 23 114155.00P&	35.810 -118.020	10		| 3.6 1|		039 32 4F	.....	139
GS	1986	06 05 150400.06E&	37.098 -116.016	0		| 5.3 62| 4.2Z	1	041 160	.....E..	132
GS	1986	06 05 152411.23	37.137 -115.998	1 G	1.30|	| 4.2 6|		041 14	.....I..	134
GS	1986	06 25 202745.10E&	37.265 -116.499	0		| 5.5 77| 4.2Z	1	041 265	.....E..	93
GS	1986	07 17 210000.06E&	37.279 -116.356	0		| 5.7 81|		041 243	.....E..	106
GS	1986	07 20 142945.50C&	37.580 -118.450	8		| 5.6 70| 5.6Z	13	040 253 5F	.....	105
GS	1986	07 20 144608.50B&	37.597 -118.423	10 G		|		040 22	.....	105
GS	1986	07 20 183853.30B&	37.558 -118.468	5 G		| 3.9 3|		040 41 5F	.....	105
GS	1986	07 21 031211.35	37.546 -118.433	10 G	0.68|			040 30	.....	102
GS	1986	07 21 081031.39	37.548 -118.384	10 G	0.59|			040 25	.....	99
GS	1986	07 21 111522.00B&	37.572 -118.482	10		|		040 33	.....	107
GS	1986	07 21 144226.60B&	37.537 -118.447	9		| 6.0 73| 6.2Z	16	040 311 6DUFG....	F.....S	102
GS	1986	07 21 144521.00P&	37.580 -118.420	6 G		|		040 1	.....	103
GS	1986	07 21 145111.00B&	37.520 -118.412	10 G		| 5.1 28|		040 87 5F	.....	99
GS	1986	07 21 145358.10P&	37.580 -118.420	6 G		|		040 1	.....	103
GS	1986	07 21 145749.43	37.531 -118.326	10 G	0.54|	| 4.7 10|		040 30	.....	93
GS	1986	07 21 150541.09+.	37.560 -118.384	10 G	0.86|			040 10	.....	99
GS	1986	07 21 151130.70P&	37.600 -118.490	6 G		|		040 4	.....	110
GS	1986	07 21 151935.40B&	37.513 -118.425	10 G		|		040 22	.....	99
GS	1986	07 21 152649.30B&	37.547 -118.503	10 G		|		040 17	.....	107
GS	1986	07 21 153650.15	37.599 -118.368	10 G	0.53|			040 16	.....	101

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.		DEPTH km	pP STN DEV	*****M A G N I T U D E S**** mb OBS Ms	F-E STA REG	*****INFORMATION***** IEMFDIPF PHENOMENA NEAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1986	07 21	154624.80B&	37.665 -118.487	10 G			040 23	.....	114
GS	1986	07 21	162644.33	37.514 -118.307	5 G	0.63		040 21	.....	91
GS	1986	07 21	170533.44	37.530 -118.453	10 G	0.69	3.6 1	040 26	.....	103
GS	1986	07 21	174855.91	37.597 -118.354	10 G	0.82		040 23	.....	100
GS	1986	07 21	181357.59*	37.664 -118.487	10 G	1.31		040 7	.....	114
GS	1986	07 21	203605.49	37.565 -118.368	10 G	0.45		040 12	.....	99
GS	1986	07 21	215144.73	37.626 -118.377	10 G	0.71		040 11	.....	104
GS	1986	07 21	220718.00B&	37.498 -118.397	9 G	5.5 56	5.02	040 185	.....G.....	96
GS	1986	07 21	234304.82*	37.519 -118.257	10 G	1.51		040 9	.....	88
GS	1986	07 22	000953.69	37.606 -118.409	5 G	0.71	4.0 3	040 30	.....	104
GS	1986	07 22	054045.38	37.594 -118.386	10 G	0.55		040 25	.....	102
GS	1986	07 22	062152.52	37.452 -118.348	10 G	0.69		040 28	.....	90
GS	1986	07 22	082916.70	37.579 -118.396	10 G	0.97		040 25	.....	102
GS	1986	07 22	122449.72	37.526 -118.443	10 G	0.55	3.7 1	040 23	.....	101
GS	1986	07 22	133359.57	37.526 -118.429	10 G	0.79	4.2 3	040 28	.....	100
GS	1986	07 22	134859.68	37.510 -118.474	10 G	1.20	4.5 4	040 38	.....	103
GS	1986	07 22	181936.36	37.494 -118.290	10 G	0.57		040 20	.....	88
GS	1986	07 22	182944.05	37.473 -118.314	10 G	0.68	3.7 2	040 30	.....	89
GS	1986	07 22	201700.10	37.554 -118.359	10 G	0.82	3.7 1	040 28	.....	97
GS	1986	07 22	202226.42	37.614 -118.409	10 G	0.62		040 22	.....	105
GS	1986	07 22	220641.80	37.513 -118.294	10 G	0.47		040 18	.....	90
GS	1986	07 23	153911.69	37.517 -118.409	10 G	1.07	4.1 3	040 29	.....	98
GS	1986	07 24	024311.28	37.583 -118.417	10 G	0.83		040 28	.....	103
GS	1986	07 24	061005.19	37.479 -118.316	10 G	0.41		040 21	.....	89
GS	1986	07 24	150500.08E&	37.143 -116.071	0		4.4 11	041 47	.....E..	127
GS	1986	07 24	190325.92	37.467 -118.297	10 G	0.67		040 18	.....	87
GS	1986	07 26	143940.70	37.526 -118.407	10 G	0.76		040 24	.....	99

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****A G N I T U D E S***** mb OBS Ms	OBS CONTRIBUTED VALUES	F-E STA REG	*****INFORMATION***** ITEMFMDI PF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1986	07 27 034940.56	37.367 -118.217	10 G	0.60	|	4.20MLBRK	040 24	.....	75
GS	1986	07 27 100802.36	37.537 -118.314	10 G	0.79	|	4.00MLPAS	040 24	.....	93
GS	1986	07 29 071158.65	37.540 -118.367	10 G	0.69	|	3.90MLBRK	040 26	.....	97
GS	1986	07 29 095757.02	37.593 -118.447	10 G	0.68	3.7 2	4.20MLBRK	040 38	4F.....	106
GS	1986	07 29 151425.20	37.447 -118.304	10 G	0.57	|	4.60MLBRK	040 23	.....	86
GS	1986	07 30 060332.15	37.633 -118.403	10 G	0.51	|	3.50MLPAS	040 27	.....	106
GS	1986	07 30 064152.78	37.562 -118.424	10 G	0.94	4.1 5	4.20MLBRK	040 44	5F.....	102
GS	1986	07 31 072240.21	37.463 -118.374	5 G	0.96	5.5 57	4.80MLBRK	040 187	5F.....	92
GS	1986	07 31 072803.80P&	37.530 -118.420	6 G	|	|	5.80MLPAS	040 12	.....	100
GS	1986	07 31 073602.40B&	37.472 -118.397	4	|	|	4.40MLPAS	040 17	.....	95
GS	1986	07 31 081539.42	37.516 -118.307	10 G	0.70	|	4.50MLBRK	040 19	.....	91
GS	1986	08 01 142716.07	37.501 -118.352	5 G	1.04	4.2 1	4.00MLBRK	040 30	.....	93
GS	1986	08 01 142818.08	37.375 -118.442	5 G	1.01	4.9 19	4.30MLBRK	040 54	.....	93
GS	1986	08 03 103304.56	37.615 -118.410	5 G	0.67	3.6 1	4.70MLBRK	040 35	.....	105
GS	1986	09 18 075947.58	37.632 -118.392	5 G	0.73	|	4.00MLBRK	040 30	.....	105
GS	1986	09 24 142033.67	37.374 -117.199	5 G	0.51	|	4.20MLPAS	040 16	.....	49
GS	1986	09 24 143555.94	37.351 -117.206	5 G	0.74	|	4.10MLBRK	040 16	.....	46
GS	1986	09 30 223000.10E&	37.300 -116.307	0	5.5	73 4.5Z	4.30MLBRK	041 218	.....	111
GS	1986	10 09 053725.24	37.358 -118.335	10 G	0.50	|	1 5.20MLBRK	040 28	3F.....	84
GS	1986	10 16 192500.09E&	37.220 -116.462	0	5.6	80	4.50MLBRK	041 219	.....	95
GS	1986	11 14 160000.07E&	37.100 -116.048	0	5.8	79 4.5Z	5.50MLBRK	041 230	.....	129
GS	1986	11 14 200238.78	37.081 -116.014	0 G	1.50	4.0 1	1 5.60MLBRK	041 11	.....	132
GS	1986	12 13 175005.09E&	37.263 -116.412	0	5.5	73	5.30MLBRK	041 212	.....	100
GS	1987	02 11 164500.06E&	37.011 -116.045	0	4.5	4	4.20MLBRK	041 32	.....	129
GS	1987	03 18 182800.09E&	37.210 -116.209	0	4.3	4	4.40MLBRK	041 39	.....	117
GS	1987	04 18 134000.60E&	37.248 -116.509	0	5.5	72 4.0Z	1 5.30MLBRK	041 236	.....	92
GS	1987	04 22 220000.09E&	36.983 -116.005	0	4.2	1	3.90MLBRK	040 55	.....	133
GS	1987	04 30 133000.09E&	37.233 -116.423	0	5.5	67 4.4Z	2 5.30MLBRK	041 245	.....	99
GS	1987	05 19 035351.00P&	36.440 -117.820	6 G	1.02	|	4.30MLBRK	040 30	5F.....	68
GS	1987	06 18 152000.08E&	37.194 -116.035	0	|	|	3.50MLPAS	041 31	.....	131
GS	1987	06 30 160500.10E&	36.999 -116.043	0	4.1	2	4.10MLBRK	040 35	.....	129
GS	1987	06 30 162324.58	36.939 -116.020	0 G	1.12	4.2 1	4.00MLBRK	040 11	.....	131
GS	1987	07 16 190000.08E&	37.104 -116.023	0	4.8	33	3.60MLBRK	041 108	.....	131
GS	1987	07 28 185511.10B&	38.383 -118.117	14	4.3	2	4.70MLBRK	040 37	4F.....	162
GS	1987	07 29 035232.50B&	38.367 -118.170	12	4.4	3	4.60MLBRK	040 44	F.....	162
GS	1987	08 03 094803.70B&	38.390 -118.060	18	3.9	1	4.40MLBRK	040 44	4F.....	161
GS	1987	08 13 140000.09E&	37.061 -116.045	0	5.9	71 4.4Z	2 5.50MLBRK	041 271	F.....	129
GS	1987	09 09 085721.11	36.098 -118.284	5 G	1.02	|	3.40MLPAS	039 19	.....	122
GS	1987	09 09 085721.11	36.098 -118.284	5 G	1.02	|	4.10MLBRK	039 19	.....	122

CATALOG SOURCE	D A T E YEAR MO DA	ORIGIN TIME	***COORDINATES** LAT. LONG.	DEPTH km	pP STN DEV	*****M A G N I T U D E S***** mb OBS Ms	F-E STA REG	*****INFORMATION***** ICMFMIDPF PHENOMENA NFAPOEDFL DTSVNWG TFPS PEDG	RADIAL DIST km
GS	1987	09 24	150000.06E&	0		5.7 67 4.3Z	041 239	.F.....	103
GS	1987	10 23	160000.09E&	0		5.2 53	041 147	.F.....	127
GS	1987	12 02	163000.08E&	0		4.1 1	041 24	.....E..	121
GS	1988	02 15	181000.09E&	0		5.3 60	041 174	.F.....	97
GS	1988	04 07	171500.08E&	0		4.0 3	041 33	.....E..	129
GS	1988	05 13	153500.11E&	0		4.8 20	041 85	.....E..	127
GS	1988	05 21	223000.14E&	0		4.3 3	041 38	.....E..	134
GS	1988	05 28	180855.50E&	3			040 28	.....	134
GS	1988	05 30	172818.90P&	6 G			040 36	.F.....	72
GS	1988	06 02	130000.09E&	0		5.4 68 4.2Z	041 207	.....E..	98
GS	1988	07 05	181847.50	5 G	0.69 4.4 7		040 74	4F.....	79
GS	1988	07 07	150530.07E&	0		5.6 65 4.3Z	041 346	.F.....	103
GS	1988	07 28	112024.29	5 G	0.65		040 61	.....	79
GS	1988	08 10	182451.36	5 G	0.62		040 54	2F.....	78
GS	1988	08 17	170000.09E&	0		5.5 82 4.2Z	041 312	.....	110
GS	1988	08 23	182959.79	5 G	0.49 4.1 1		040 59	.....	132
GS	1988	08 30	180000.09E&	0		5.0 47	041 172	.....	127
GS	1988	10 08	211420.10P&	6 G			040 45	2F.....	104
GS	1988	10 13	140000.08E&	0		5.9 82 4.4Z	041 340	.F.....	129
GS	1988	10 13	161807.85S&	0 G	4.5 3		041 23	.....	129
GS	1988	10 19	160823.80B&	13			040 64	3F.....	87
GS	1988	11 22	075739.56R&	7			040 46	.F.....	104
GS	1988	12 10	203000.06E&	0		5.0 33	041 138	.....	116
GS	1989	02 10	200600.06E&	0		5.2 54	041 198	.....	133
GS	1989	02 24	161500.08E&	0		4.4 4	041 64	.....	123
GS	1989	03 09	140500.09E&	0		5.0 19	041 132	.....	128
GS	1989	04 20	124552.77	4	0.66 4.3 4		037 79	4F.....	167
GS	1989	05 15	131000.09E&	0		4.4 7	041 48	.....	123
GS	1989	06 22	211500.83E&	0		5.3 54 4.8Z	041 221	.....	101
GS	1989	06 27	153000.02E&	0		4.9 25	041 102	.....	106
GS	1989	07 11	041334.20B&	12		4.1 3	040 44	5F.....	111
GS	1989	09 14	150000.10E&	0		4.2 4	041 43	.....	121
GS	1989	10 31	153000.09E&	0		5.7 55	041 270	.....	94
GS	1989	12 08	150000.09E&	0		5.5 61 4.2Z	041 213	.....	100
GS	1990	01 15	052903.45	5 G	1.08 4.4 6		040 60	4F.....	126
GS	1990	03 07	071636.70B&	11			040 28	3F.....	112
GS	1990	03 10	160000.08E&	0		5.0 44	041 152	.....	129
GS	1990	03 10	172630.30S&	0 G	4.0 3		041 18	.....	129
GS	1990	06 13	160000.01E&	0		5.7 85 4.5Z	041 340	.F.....	100
GS	1990	06 21	181500.00E&	0		4.0 5	040 33	.....	133
GS	1990	07 25	150000.06E&	0		4.7 24	041 77	.....	116
GS	1990	10 12	173000.08E&	0		5.6 75 4.2Z	041 235	.F.....	93

DEATH VALLEY SCOTTY HISTORIC DISTRICT, MAIN HOUSE AND ANNEX HSR

APPENDIX E, MONITORING REPORT FOR THE BRIDGE DURING THE PEPATO EVENT AND OTHER LOADING CONDITIONS

Superintendent

7/2/79

Unit Manager

Field trip report during Nevada Test Site activity

Enclosed is the field trip report prepared by Gerald Kralik of URS/John A. Blume & Associates who was at the Castle during the June 11, 1979, detonation. He monitored the vertical movement of the walkway bridge during the event.

His conclusion provides interesting reading where he points out that normal tours create more vertical motion than the tests. This would indicate to us that the number of tours creates some stress on the building.

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Jack Fields

cc: Tom Mulhern, WRO

FIELD TRIPS TO SCOTTY'S CASTLE

URS/JAB/GWK 6-18-79

Numerous field trips were made to Scotty's Castle by GWK in preparation for Event PEPATO. GWK was stationed at Scotty's Castle during brief periods of the day on May 31, June 1, June 4, June 5, June 10, and June 11, 1979. Event PEPATO was finally detonated at 7:00 A. M. on Monday, June 11, 1979. The general purpose for GWK being stationed at Scotty's Castle during Event PEPATO was to monitor the response of the walkway bridge located at the main house of the castle area during the subject event and to also paint some existing architectural cracks located around the walkway bridge area with silver paint in order to check for continuity of the conductive paint across the crack edges before and after the subject event. The subject walkway bridge was monitored because of the concern by the park ranger, Mr. Jack Fields, of the bridge movement in the vertical direction during normal foot traffic loading conditions as well as possible ground motion loading conditions and the resulting exterior architectural cracks in the exterior stucco. Mr. Fields wanted to know if event ground motion generated from NTS event testing activity was responsible for some of the exterior stucco cracks to the walkway bridge.

The attached Table 1 summarizes the results of the response of the walkway bridge during various types of vibration monitoring tests. The results of the vertical response of the walkway bridge during Event PEPATO are also listed in Table 1. Also attached is Table 2 which shows the results of the site response on the ground during Event PEPATO as recorded by a 3-channel L-7 system. The vertical direction of response of the walkway bridge during Event PEPATO was chosen as the direction to monitor with the uniaxial VM-1 because of the distinct vertical vibration felt when one walks across the walkway bridge, which was the main reason for monitoring the response of this bridge during the subject event activity. It should be noted that the vertical direction of this walkway bridge is the most flexible direction of response. Event PEPATO was chosen as the specific NTS event for recording the response of the walkway bridge because of the design yield ranging from 20 to 150 kilotons. The general conclusions reached after comparing the magnitudes of motion (recorded in terms of absolute acceleration) in the

Page 2

vertical direction revealed that the subject event activity caused the lowest magnitude of vertical response as compared to the group of six tour guides walking across the bridge in a group walking in a normal pace and speed. Mr. Fields told GWK that it was not uncommon during the heavy tourism time of the year to find twenty-five people walking in a group across the span of this particular bridge; the magnitude of vertical response of this walkway bridge would therefore be much greater for twenty-five people walking across this bridge as compared to the field test results obtained from having six people walking across the bridge. Therefore, the comparison of these magnitudes of motion suggests that the bridge responds much more significantly in the vertical direction due to normal traffic loading conditions as compared to what the response has been during the recent NTS event activity (the NTS event activity since the conclusion of the accelerated test program which ended in March, 1976).

Six particular cracks located in and around the walkway bridge area were painted with silver metallic conductive paint just prior to the detonation of Event PEPATO. The continuity of the paint across the crack was checked in the presence of Jack Fields just prior to the subject event activity and the surface of the paint was also closely inspected in order to check for observable surface cracking in the paint. The actual locations of the six painted cracks are located on a sketch which will be kept in the permanent URS/Blume files and will not be presented in this report. These six particular painted cracks were then checked for continuity after the subject event activity in the presence of Mr. Fields. General inspection of the surface of these painted spots as well as the check for the continuity of the silver paint across the cracks with an ohmmeter revealed that no aggravation of these six particular cracks had taken place during the subject event activity. The results of this particular study therefore indicate that the magnitude of ground motion generated by Event PEPATO was not significant enough to cause the walkway bridge to respond in a manner so as to cause the worsening of previously existing architectural cracks in the exterior stucco. GWK feels that these particular minor stucco cracks in and around the walkway bridge are caused by a combination of normal foot loading conditions, normal expansion and contraction of the structural and architectural elements,

Page 3

and normal deterioration of the relatively old stucco plastering (the stucco is approximately 45 years old).

During the time of Event PEPATO, GWK was operating the VM-1 machine and felt a slight vertical movement of the walkway bridge and also felt a slight movement in the horizontal direction; this would correspond to a perceptibility reading of 4. Mr. Jack Fields was located in the south wing of the main house on the second floor level watching the relatively huge and heavy ceiling-hung chandelier sway in predominately the direction toward ground zero (the location of detonation of Event PEPATO); Jack Fields said that the peak-to-peak swaying of the chandelier was approximately two inches. The initial compression pressure wave generated from the detonation of Event PEPATO made the building windows rattle enough such that GWK could hear this noise while located on the walkway bridge (where the door leading to the second floor of the south wing of the main house was open).

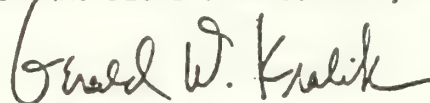
Also, on June 1, 1979, GWK and Jack Fields reviewed the photographs taken with the 35mm camera during a prior field trip on April 24, 1979 (this trip was made in order to install the 3-channel L-7 ground station). The results of a close inspection of these photographs and the comparison with older photographs of the same areas revealed that there was only a slight worsening of a few of the previously existing cracks photographed approximately three years ago (last photographed February 3, 1976). The slight worsening of a previously existing severe architectural crack located near the top of the north archway beam-column near the east wall elevation of the powerhouse was revealed during the comparison of the three-year-old photographs with the recently taken photographs. It was impossible for GWK to get up to the top of the beam-column in order to try and move this area of the archway beam-column located above the crack in order to see if the top stucco plaster coating would move relatively easy due to hand applied pressure. Jack Fields was concerned that this particular chunk of plaster may slide off the archway beam-column any time; GWK suggested to Jack Fields some of the maintenance people get up there and try and determine whether or not it should be removed (due to instability) and repaired or whether or not it is safe under the currently existing conditions. The only other area involved a

Page 4

slight worsening of previously existing damage concerning the crack that was previously mentioned in a previous report (GWK's report dated 4-24-79) which was located on the extreme east face of the walkway bridge that was located in the stucco and on the north end of the bridge; this particular crack had a new crack branching out from the older crack that was not shown in the photographs taken three years ago. GWK had previously mentioned that because of this new crack branching out, that a particular chunk of stucco appeared to be relatively loose and unstable, and could therefore fall at any time due to aggravation of the walkway bridge caused by normal foot traffic loading or relatively strong gusty winds. GWK noticed that on his departure from Scotty's Castle on 6-11-79, that this particular chunk had been removed. Close comparison of all the other photographed areas involving exterior cracks around particular structures located at this historical site revealed that there didn't appear to be any visual worsening of the other previously existing cracks.

In conclusion, it appears that during the last three years that only some slight worsening of the previously existing severe exterior cracks has taken place. The results of the response of the walkway bridge in the vertical direction during the subject NTS event activity as compared to the response caused by normal loading conditions revealed that normal loading conditions aggravate the bridge in the vertical direction much more in magnitude than what is caused by event activity during the recent testing program conducted at the Nevada Test Site. The majority of the other previously existing cracks do not appear to have been aggravated by recent NTS activity. Therefore, it does not appear that any recent NTS event activity has produced ground motion significant enough to worsen any of the previously existing damage, which also suggests that the origination of new damage in the future is rather unlikely.

URS/JOHN A. BLUME & ASSOCIATES, ENGINEERS

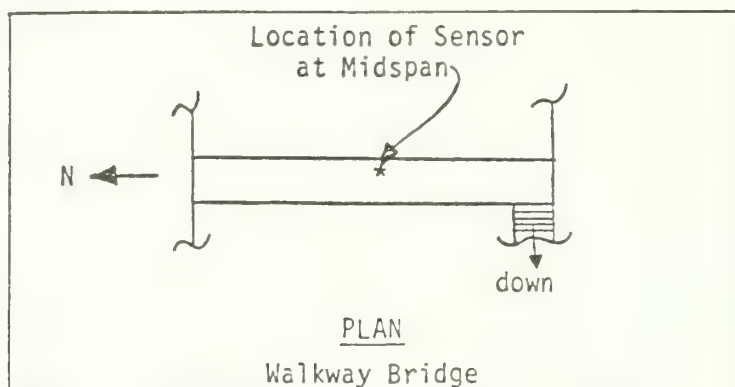


Gerald W. Kralik, P. E.

xc: P. N. Halstead, DOE
M. Page, Jr., DOE
Jack Fields, Natn'l. Park Service, Furnace Creek, Calif. 92328

SCOTTY'S CASTLE

VM-1 Vibration Monitor Test Results

TABLE 1

TEST NO.	TYPE OF LOADING	DATE OF TEST	COMPONENT	PEAK $\vec{a}(g's)^1$	T(sec) ²	f(hz) ³
1-3	Vertical Impact loading caused by GWK (200 lb.) jumping down one time about 3' west of sensor	6-1-79	Vertical	$\geq .1g$	.08	12.5
			E/W	.016g	.075	13.33
			N/S	.006g	.060	16.67
4	Vertical loading caused by 6 tour guides walking normally and in a group across the bridge	6-1-79	Vertical	.012g	.077	12.96
5	Ground Motion Generated by Event PEPATO	6-11-79	Vertical	.004g	.08	12.5

1. Peak \vec{a} is the peak absolute acceleration in terms of fractions of $1g(1g = 32.2 \text{ ft/sec}^2)$
2. T is the fundamental period in seconds
3. f is the fundamental frequency in cycles per second or hertz ($f = 1/T$)

SCOTTY'S CASTLE

GROUND STATION RESPONSE - EVENT PEPATO

Instrument Location: Basement of south wing of the main house, north end of the wing along N/S centerline splitting the length of the south wing

Type of Instrument: 3-channel L-7

Date/Time of NTS Event: Monday, June 11, 1979 @ 7:00 A. M.

TABLE 2

RESULTS OF GROUND MOTION RESPONSE

COMPONENT	Peak \vec{V} (cm/sec.)	T(sec)	Peak \vec{a} (g's) ¹
Vertical	.0569	2.46	.00015
E/W	.1138	3.14	.00023
N/S	.0853	3.14	.00017

$$1 \quad \text{Peak } \vec{a} \text{ (in g's)} = .0064 \left(\frac{\text{Peak } \vec{V} \text{ (cm/sec)}}{T} \right)$$

APPENDIX F, A HISTORICAL RECORD OF NUCLEAR TESTING - AN ANNOTATION OF CORRESPONDENCE

NUCLEAR TESTING PAPER TRAIL--DEVA 357

- 1/3/76 MUENSTER event (nuclear test) appears to have, for the first time, officially resulted in serious concern.
- 1/12/76 Super. Thompson sent complaint letter to ERDA (energy research and development administration, later same as DOE, dept. of energy)
- 1/21/76 letter to DEVA Supt. from M.E. Gates, manager, ERDA, Nevada Operations Office, Las Vegas:
1. acknowledging receipt of Supt. complaint
2. "Procedures are being implemented to assure that your agency receives proper notification of scheduled high yield tests which may be conducted at the Nevada Test Site that might be discernible at the Death Valley National Monument and at Scotty's Castle."
- 2/1 or 2/76 An inspection was made vis-a-vis the 'complaint' by D. C. Duff, General Adjuster, General Adjustment Bureau, Inc. The report is dated 2/12/76 and includes the following quotations:
"All of the damage involved in the complaint is of a similar nature; being recently noticed cracks which have appeared in various areas of these structures."

"The damage noted does not appear fresh or recent, but considering the construction and age of the involved there is the possibility the recently noticed damage is attributable to the event related ground motion."
(emphasis added)

"Interior cracks in several castle bedrooms appear recent and fresh as do hairline cracks in a guest bath." (emphasis added)

"The integrity of the basic structure can very well be intact with the decorative portion, evidencing the results of ground motion."

"There was extensive ground motion, sufficient to cause merchandise in the souvenir/concession area to be knocked from the walls and shelves. We believe the complaint as submitted by reputable persons must be considered as damage attributable, to some extent, to event related ground motion."

RECOMMENDATIONS

We recommend the file be held in abeyance, as we arranged for National Park Service Personnel to monitor the noted damaged areas during the time of future events.

When the results of this monitoring are known, we shall re-evaluate the complaint and submit reports accordingly." (emphasis added)

2/2/76

Trip Report (dated 2/25/76) to WRO regional director and to the Supt. through Asst Mgr. from C. P. Deissner concerning an examination of damage at Scotty's Castle resulting from 1/3/76 MUENSTER event:

"Damage did occur at Scotty's Castle The structural damage is not significant. The repair of damage to plaster, stucco, etc., that can be proven as directly attributable to the January 3 test is estimated to cost between \$1,500 and \$2,000 if accomplished by NPS maintenance personnel. If the repair is by off-site contractor, the cost is estimated at \$6,000 to \$8,000."

A separate and "supplementary" report including photographs was prepared by Deissner.

2/27/76

letter to the CA SHPO form ERDA (Roger Ray, Asst. Mgr. for Environmental Safety) indicating:

"We have been working with the NPS regarding damage reported to us following the underground nuclear test detonated on Jan. 3. On Feb. 2-3 an engineer from URS/John A. Blume & Associated, along with representatives for this office, and the General Adjustment Bureau visited with the NPS personnel and investigated the damage which was of concern to them. [Copy of Duff report and of Runge report were attached.] On Jan. 22, a member of this office along with representatives from the Environmental Protection Agency visited NPS personnel and established new procedures for timely communication with the NPS to notify it of any future ... tests... from which the expected ground motions are large enough to be of concern in Death Valley. (emphasis added)

R. F. Runge, P.E., investigator, REPORT OF DAMAGE INVESTIGATION 1/2-3/76 signed by Roger E. Skjei, URS/BLUME.

"Although all the exterior stucco cracks probably were in existence prior to the

MUENSTER Event, Scotty's Castle is located within a range of ground zero that extension and aggravation of some existing cracks is possible." The cracks were described as follows: "There were numerous exterior stucco cracks in all the buildings; some were quite large, particularly in the bridge that spans the patio of the ranch house, and also along the steps of the Hacienda and the caps on the arches of the power house. There were also cracks in the exterior surface of the chime tower. All the stucco cracks appeared to be quite old."

3/4/76 memo to WRO Regional Director from DSC covers TRIP REPORT, FEB. 2-5, 1976 by Structural Engineer C. P. Diessner.

PURPOSE-to examine damage at Scotty's Castle ... resulting from the Jan. 3, 1976 atomic test...

SUMMARY-Damage did occur at Scotty's Castle... as a result of the 1/3/76 ERDA test. The structural damage is not significant. see above noted info.

3/14/76 letter to Mr. William Gates, Director, ERDA, NV Operations Office from Supt. Thompson, DEVA. The letter is complementary of ERDA for providing on-site personnel during tests of 3/9 and 3/14. The personnel were on-site to "monitor the effects of the two tests". no results noted.

3/15/76 memo to Reg. Director from Supt. DEVA transmitting a report (see below). The letter states:

ERDA and EPA personnel [on-site for the tests] were most cooperative. Although measurable effects are not pronounced, accumulative effects may be considerable. We are concerned, not just for structural integrity but for disintegration of the historic fabric of the entire complex. We agree with Mr. O'Toole's recommendation for more monitoring, but request that DSC recommend an approach.

3/14/76 Mr. O'Toole's memo to the Supt.:

SUBJECT: Atomic Tests - ESTUARY (3/9/76) and

COLBY (3/14/76)

The ESTUARY test was witnessed from the top of the Chimes Tower. "Two distinct, slight swaying motions were felt... I would estimate the duration of same at approximately five seconds." 5 minutes after the test, they entered the Great Hall and "observed the chandelier swaying in a circular motion with a radius of one inch from its center point."

COLBY: a "metallic paint" was placed "on several small cracks along the bridge...as well as on one of the stress member beams of the roof in the interior of the Great Hall." via radio contact, motion reached the Castle "15 seconds" after firing. The duration of "ground motion and observable building movement was approximately 15 seconds." "After building motion subsided, the chandelier in the Great Hall was observed to be moving in a circular motion with a radius of three inches from its center point." Motion in the Main House seemed more noticeable" than in the Annex. A "Perceptibility Code rating of 'four'" was assigned by the monitoring engineer, indicating "that the motion was distinctly felt, and that the direction of the building motion could be identified." The result of paint on cracks:

1. The cracks on the Castle bridge which were monitored showed no sign of extension.
2. The stress member beam inside the main Castle building showed no sign of extension.

Note: In reference to Item 1 and 2, although motion was definitely observed, it was felt that the two buildings and the bridge moved separately but that each moved as a complete and distinct unit. In other words, either the bridge and steps moved as a complete unit, or the movement at the points being monitored was so slight that the paint was not affected.

5/11/76

Letter to Supt. DEVA from Roger Ray, Assistant Manager for Environment and Safety transmitting an engineering report covering the COLBY test (see below). The letter advised:

Mr. Honda [URS/John A. Blume & Associates] identified two locations which exhibit advanced stages of deterioration. While neither location presents an immediate hazard, in his judgment, the condition will

worsen with time unless corrective action is taken. He further notes that while the damage reflects normal deterioration caused by natural forces, event ground motion from tests at the Nevada Test Site may have aggravated the existing defects.

4/26/76

Letter REPORT to ERDA from URS/Blume as enclosed in above letter to Supt. DEVA. Says:

...he noted that there are two locations showing evidence of long-term deterioration which may in time become hazardous, and which we think might be called to the attention of the responsible authorities.

One of these involves the stucco coating on the sides and bottom of the concrete [sic] bridge which connects ... Aging, thermal effects, and differential settlement have caused some cracking in the stucco. The underlying wire mesh which attaches the stucco to the bridge concrete [sic] has become weakened through exposure to weathering, with a resulting partial separation of the stucco coat.

... crack observed at the end of one of the timber roof trusses in the south castle [sic] building. The bottom cord of the truss is notched at the ends to support the axial load from the top chord. Aging and stress concentration have combined to sever the notch at one end, and the forces in the truss are apparently being carried by a 3/4" bolt connecting the top and bottom chords. Also, due to some apparent shifting, the connections of one of the secondary truss members has become loosened.

... these problems arise from normal deterioration caused by differential settlement, temperature effects and aging, and are not the results of ground motion from NTS events, although event ground motion has certainly caused some working and perhaps aggravation of existing defects.

6/28/76

memo to Supt. DEVA from Asst. Mgr. DSC with suggestions concerning the 3/15/76 memo requesting monitoring assistance:

1. use a university
2. use ERDA's consultants, J.A. Blume

3. maybe use EPA, Nat'l Env. REsearch center, Las Vegas.

A cost estimate for this program including preparatory work, equipment, monitoring and reports would be about \$30,000 for the first year, \$15,000 for the second year and \$10,000 for the third year. recommended course of action is also provided....

11/9/77

a personal REPORT by C.G. Johnson, interpretive specialist to Scottys Castle Unit Mgr. concerning monitoring of Atomic test at the Castle. It mostly concerns notification and evacuation procedures but includes the following:

At 2:00 PM, from a position in the house...I monitored two tremors of low intensity. The first lasted about 7 seconds, followed by a lull of about 6 seconds and a second tremor of about 5 seconds. During this time I noted a definite movement of the chandelier, creaking of the walls and beams and a very minor movement of other articles. ...[no damage was found]

6/18/79

FIELD TRIPS TO SCOTTY'S CASTLE an extensive REPORT by Gerald Kralik, P. E. of JR Blume covering visits during May and June 1979 and including serious monitoring (with instrument obtained data) of the PEPATO event of 6/11/79. see document attached.

APPENDIX G, MODIFIED MERCALLI INTENSITY SCALE

Modified Mercalli Intensity Scale of 1931

- I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.**
Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.
- II Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.**
As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.
- III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.**
Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.
- IV Felt indoors by many, outdoors by few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.**
Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.
- V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.**
Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well filled open containers. Trees and bushes shake slightly.
- VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.**
Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows, break. Knick-knacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.
- VII Frightens everyone. General alarm, and everyone runs outdoors.**
People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction, slight to moderate in well built ordinary buildings, considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.
- VIII General fright, and alarm approaches panic.**
Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes, considerable in ordinary substantial buildings, with some partial collapse, heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed plings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.
- IX Panic is general.**
Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes, great in other masonry buildings — some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.
- X Panic is general.**
Ground, especially when loose and wet, cracks up to widths of several inches, fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations, are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.
- XI Panic is general.**
Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few, if any masonry structures remain standing. Supporting piers or pillars of large, well built bridges are wrecked. Wooden bridges that give are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.
- XII Panic is general.**
Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

APPENDIX H, INFORMATION FROM HISTORIC RECORDS ON STUCCO AND PLASTER

INFORMATION FROM HISTORIC RECORDS ON STUCCO AND PLASTER

Excerpts from historic correspondence and other documents and notes describing the contents of documents.

Letter, A. M. Johnson to C. A. MacNeilledge, October 26, 1926. Discussion and instructions regarding lumber, windows, brick, plaster, hollow tile, cement, Insulex and "plaster bond and the ties...between the hollow brick [clay] tile and the studding."

Letter, C. A. MacNeilledge to A. M. Johnson, October 30, 1926 (the letter also included discussion of windows, lumber and heating):

I have your letter of the 26th inst., and contents noted. 1 car of Stucco will go forward Monday containing also 6000 sq. ft. of Celotex wall board, Plaster Bond, and Hydrate Lime. The colors are to be used as follows: all exteriors of both buildings to have no. 18 finished as sample, which is a float finish with a top dash brushed down with a broom, then to have a brush coat of the light no. 48 which will have a weathered adobe effect. This is a different material from no. 48 stucco, but same color. No. 48 is to be used also for interior of Commissary, except Kitchen rough troweled as sample. No. 682 for Living Hall. No. 44 West Apt. 2nd floor. No. 32 East Apt. 2nd floor. No. 48 Kitchen and office and West Apt. 1st floor of the main building, finished as sample, all of which I am sending to-day.

The interiors over concrete should have coating of plaster bond and scratch coat. 1 of hardwall and 2 sand, darby finish, then apply stucco about 1/4 to 1/2 in. thick.

Exterior over concrete, coating of plaster bond, dash coat of 1 cement, 3 sand, broom over surface, then stucco.

Finish over Tile: Exterior, coat of plaster bond, 1 cement, 3 sand, scratch coat 1/2 to 3/4 in. thick. Add 10% of Hydrate Lime to cement by weight, then stucco.

Letter, Blue Diamond Co., (Building Materials), Los Angeles, to Death Valley Mercantile Co., December 8, 1926. Instructions for use of No. 48 Art_Rok Cement, a cold water paint for "the cold storage room and shower in the Commissary Building."

Letter, C. A. MacNeilledge to F. X. A. Kreil, January 18, 1927. Instructions for installing ties for clay tile, and for forming, mixing and installing Insulex.

Stucco specifications by C. A. MacNeilledge (transcribed):

Stucco Specifications, C. A. MacNeilledge, June 25, 1927

Mr. Johnson's Sitting Room:

No. 32 ground, with #48 highlight, Latin Texture

Mr. Johnson's Bedroom:

No 48, Texture Mexican, same as garage.

Guest Sitting Room:

No 44, Texture Latin

Living Hall:

No 682, Mexican

Living Room:

No 682, Mexican

Library:

No 48, Texture Mexican

Solarium:

No 32, Texture Latin

Scott's Room:

No 48, Spanish Texture

Kitchen: No 48, Spanish TextureKitchenette: No 32 ground, with 48 highlight [, Latin is handwritten on the list]Bedroom: No 48, MexicanGuest House living room: No 32 MexicanBedroom: No 48 SpanishHalls: No 32 MexicanTower Entrance Guest House: Exterior Stucco for Interior Color?Main House Tower: " " " " "Stone Balconies - Chimney: No 48 TravertineArch South Porch Bridge over Patio ?Exterior Stucco - Stone Blocks. Travertine Finish 1/4" jointsOutside Chimneys: Sand finish cement, block off in stone Heavy joints.

STUCCO SPECIFICATIONS Per C. A. MacNeilledge June 25, 1927

GUEST HOUSE LIVING ROOM: No 32 Mexican

BEDROOMS: No 48 Spanish

HALLS: No 32 Mexican

Letter, M. R. Thompson to C. A. MacNeilledge, July 7, 1927. Described tile missing from a shipment and the Kitchenette, including lack of instructions for stucco texture. This was followed by the following letter:

Letter, M. R. Thompson to C. A. MacNeilledge, July 9, 1927:

Just a word to correct statement in my letter of the 7th: The Kitchenette has had two coats of plaster but the finish coat has not started yet. The little bedroom has been finished with Mexican texture and floor tile is now being laid. The plasterers are uncertain what texture you want in the kitchenette as the specifications do not indicate it. They at first assumed you wanted Mexican because it is specified in the bedroom but as the Kitchenette calls for No 32 ground with 48 highlight, that is not adapted to Mexican finish according to them. They will wait until hearing further from you before finishing the Kitchenette.

Letter, C. A. MacNeilledge to M. R. Thompson, July 11, 1927:

The finish of stucco in Kitchenette is to be same as Mr. Johnson's Sitting Room, Latin texture.

"Memorandum of order given for California Stucco, September 29, 1927, copied by M. R. Thompson, October 11, 1927". Instructions for mixing and application of acoustic plaster, exterior stucco, finishing coat, exterior travertine and bath room plaster, with California Stucco Products Co. and Blue Diamond color numbers.

Letter, C. A. MacNeilledge to A. M. Johnson, November 8, 1927:

I returned from the Ranch Sunday. I found the work progressing very satisfactorily. About two thirds of the main building has the final stucco finish, also part of annex. I am very pleased with the color and texture. It was quite a struggle to get the desired effect as it had never been done before, but I feel sure you will approve of it when you see the building.

Letter and invoice, Sawyer-Hassett Co., Los Angeles, to Death Valley Mercantile Co., December 30, 1927. Regarding billing and instructions -- plaster, stucco, Keenes cement, Insulex, travertine (stucco).

Note, "Stucco Textures for Guest House", per C. A. MacNeilledge, May 28, 1928.

Letter, California Stucco Products Co., Los Angeles, to H. B. Brown, June 15, 1929. Letter regarding shipment of stucco to mix with previous incorrect shipment to achieve proper color; includes mixing instructions.

Letter, California Stucco Products Co., Los Angeles, to Thompson and Brown, March 15, 1930. Regarding shipping of interior stucco and instructions for mixing to get correct color (with material already on-site, which was too dark).

List of products available from California Stucco Products Co., Los Angeles, July 1, 1930, includes metal lath, plaster accessories, stuccos and plasters.

Letters from M. R. Thompson to A. M. Johnson describing the waterproofing of concrete walls with McEverlast (asphaltic coating) include February 2, 5, 9 and 19, 1930. These letters would imply that they were just starting to use the McEverlast product and were using it on the Powerhouse.

—mini balls



1725.32

✓	SUPERINTENDENT	10/14
✓	CHIEF RANGER	11
	ADMIN. OFFICER	
	CHIEF INTER.	
✓	FAC. MANAGER	
	CHIEF MINING	
✓	UNIT MANAGER	20
	RES. MGT. SPEC.	

10/11 3/13

DEATH VALLEY SCOTTY HISTORIC DISTRICT, MAIN HOUSE AND ANNEX HSR

1) reinforced concrete; 2) hollow ceramic tiles with brick jambs and returns; 3) studding covered with wood sheathing and/or celotex; and, 4) open studding, or there may be varying combinations of each type incorporated into a single elevation.

The stucco system is constructed by differing methods over each of the different structural systems and, in general, are as follows:

Reinforced Concrete Wall Construction: Walls vary in thickness from 8" to 14" and are reinforced using deformed steel bars. The concrete wall surface was painted with a black material, probably tar or asphalt, with the first stucco coat being portland cement plaster (3/8" thick) applied directly to this black coating. The second coat of portland cement (3/8" thick), or the leveling coat, was applied directly over the first coat. A third coat of very thin dark colored cement (approximately 1/8" thick), probably Keene cement, was applied directly over the second coat. Before it had set, it was scratched vertically using a 3/8" wide steel scratcher. A fourth and final coat of cream colored pigmented cement, probably Keene cement too (approximately 1/16" to 1/8" thick), was applied in daubs and troweled to cover approximately 75 percent of the surface area, allowing 25 percent of the scratch marks to show as part of the finish. This two-coat system of different colors and textures was designed to give a "weathered adobe" appearance.

Hollow Ceramic Tiles with Brick Jambs and Returns: This system is treated the same as the "Concrete Wall Construction" except the wall surfaces have not been primed with tar or asphalt.

Stud Partitions Covered with Wood Sheathing and/or Celotex Sub-Sheathing: The sheathing is covered with overlapping three-foot wide sheets of tar paper or asphalt saturated rag felt, then covered with painted expanded metal lath fastened to the studding with nails. The metal lath is covered with a coat of either portland cement plaster or gypsum cement and the finished two coats are the same as described under "Structural Concrete."

Open Studding Partitions: This system is the same as described under section "Stud Partitions."

These differing structural systems are causing unusual differential expansion, resulting in the cracking of the stucco at the intersection of these structural changes.

Most of the failures identified, however, are the result of surface "glazing," small cracks radiating in all directions without a defined pattern. Most of the stucco failures fall in this general class. This condition is the result of too fast hydration during original construction. The stucco was allowed to dry out before it set properly or was cured.

This "glazing" condition has given the stucco an unusual appearance which now forms a part of its architectural character and presents some very difficult long-range preservation problems. At the present time, however, this condition does not appear to be of a major concern.

The larger cracks generally follow a change in construction, materials, or detailing, and they are the result of thermal expansion or a differential expansion rate of materials and are presenting a more serious problem.

I feel that the larger cracks are not caused as a result of a structural failure or uneven settling because these cracks do not carry through the walls. As a matter of fact, the interior walls show "no" cracking at all, clearly indicating the major problem is in the exterior wall surface only, thus supporting the theory that thermal expansion and accelerated hydration during the original construction period has resulted in this condition.

At least eight differing stucco finishes were identified. These unusual finishes represent a highly sophisticated use of tools, material types, and techniques. To match the existing colors, textures, and ambience of these finishes will present a most difficult challenge.

It is my opinion it will be all but impossible to procure on the open competitive market the skills, knowledge, or ability necessary to replicate these sophisticated finishes. Besides the factors of being remote, and the extreme of this hot and dry climate, compounded by the problems being experienced during the original construction period of procurement of stucco supplies and materials from three different manufacturers, the techniques for repairs will differ greatly from those used during the original construction. These repair techniques will have to be developed by trial and error to match each of the different styles of stucco.

GENERAL:

The selection of materials for use in the stucco repairs will be critical, primarily due to matching the original colors and textures and from a workability and performance standpoint. Most critical will be the selection of the cements, the original stucco material having come from three different manufacturers, which has now faded over 50 years, in addition to the associated wear. The second most important is the selection of the aggregate. Sand used was probably from a gravel pit located on site and, if this site can be located, the aggregate required should not present a serious problem. The sand is a very important part of the stucco because of the troweling technique used. It is now partly exposed on the surface, adding a second dimension to the mixture of colors with that of the cement matrix. It is this combination of colors that gives the existing stucco its particular color cast and variation of appearance.

If special attention is not given to the selection of these basic materials, it will be almost impossible to make an accepted repair.

RECOMMENDATIONS:

Prior to the commencement of any major stucco repairs, a research program should be undertaken to determine the full impact of this action. A work directive should be prepared outlining the extent of the problems to be addressed, so a "Section 106" can be prepared to approve the removal of stucco samples from the structures for laboratory examination. Until laboratory tests can be conducted, it is almost impossible to determine the exact materials used or their properties. Only after these materials have been identified can a search for satisfactory replacement materials be conducted.

Only after the selection of the repair materials is completed can experimenting begin with samples to replicate all the different stucco types and finishes, and special tools required. Materials and tools for repairs will differ from the original application of stucco. The samples should be representative of all design and environmental consideration such as texture, color, temperature controls, moisture content, tool selection, and special problems with curing, etc. After the technical problems are worked satisfactorily with the samples, the cook house should be the first structure where major repairs are undertaken, primarily because of the existing poor exterior conditions. Only after successful repairs have been completed should the stucco repairs be attempted on any of the remaining structures.

If the wall temperatures are allowed to exceed 85 degrees fahrenheit during the first 72 hours of the stucco being repaired, irreparable damage will occur to the repair materials. For this reason this work should be carried out only during the winter months, or at nights and under rigidly controlled conditions. The areas being repaired should never be exposed to direct sunlight during the repair process or the immediate 120 hours following.

The research and development program should be carried out under the direction of a technically qualified masonry expert. The Denver Service Center (DSC) can provide this service but I cannot address the availability or estimated costs for this service.

Two A&E firms with this capability are:

Chambers and Chambers, Akron, Ohio

John Milner and Associates, West Chester, Pennsylvania

The WPTC for logistical reasons could not undertake a project of this magnitude. We simply are not staffed or equipped to perform projects of this type or duration.

SAFETY:

During the inspection, three different types of stucco failures were identified that could pose a safety problem to the park staff or the visiting public.

The first of these conditions is the result of the delamination between the coats of cement that form the stucco finish. A separation between the inner and outer layers has allowed the outside layer to dislodge and fall. This condition can be identified by the misalignment of the stucco surface forming an outward bulge. In general, this area covers less than one square foot and, if lightly tapped with a solid object, will have a hollow sound.

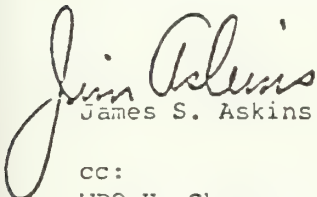
The second condition is a ceiling failure where the full stucco thickness has come loose from the structural concrete. This failure falls along the line of the tar or asphalt coating, resulting from a lack of a mechanical bond between the stucco and the concrete. These failures may be as large as four to five square feet, weighing upwards of 50 to 60 pounds.

The third condition is where a complete wall section has come loose from its structural system. This is a fastening failure caused by one of two conditions: 1) either the nails that secure the metal lath to the studding have pulled loose, or 2) the heads of the nails have stripped through the metal lath. This condition can be determined by the outward bulging of the stucco and, when tapped on the surface lightly with a solid object, will produce a hollow sound.

In all three cases the stucco can be secured in place temporarily by using a series of 4" x 4" x 1/4" thick plexiglass washers fastened with wood screws into the studding, or into plastic anchors in the concrete. This system will secure the stucco safely until such time as a decision can be made on how to repair or replace these problem areas.

I wish to thank the park staff for their cooperation and assistance during my site visit.

If I may be of further assistance, or can provide additional information in regard to this matter, please advise.



James S. Askins

cc:

WRO-H. Chapman

WRO-B. Cox

Scotty's Castle-J. Fields

Scotty's Castle-J. May

APPENDIX J, STUCCO PRESERVATION COMPLIANCE DOCUMENTATION



United States Department of the Interior

NATIONAL PARK SERVICE
DEATH VALLEY NATIONAL MONUMENT
DEATH VALLEY, CALIFORNIA 92328

IN REPLY REFER TO:

L7617

August 4, 1988

MEMORANDUM

To: Regional Director, Western Region
From: Superintendent, Death Valley National Monument
Subject: FONSI and Environmental Assessment for Scotty's Castle
Stucco Restoration

Attached, for your review and signature, are the subject documents for the Scotty's Castle stucco restoration project.

Edwin L. Rothfuss

Finding of No Significant Impact
Scotty's Castle Stucco Restoration
Death Valley National Monument

Background

Deterioration of the original exterior stucco surfaces of historic structures at Scotty's Castle has occurred unchecked since the buildings' construction in the early 1900's.

Proposed Action

The National Park Service proposes to restore the original stucco surfaces using a stucco manufactured from the source of the original material, that is, stucco aggregate screened from fill in Tie Canyon wash. Such restoration requires that 10-12 cubic yards of gravel per year be removed (by front-end loader) from Tie Canyon wash and screened onsite for use in stucco manufacturing.

Summary of Alternatives Considered

The alternative of no action, while obviously eliminating environmental impacts, would allow the historic structure to deteriorate further. Obtaining the material elsewhere, the other alternative, would be equally untenable: material of duplicate color and size ratio could probably not be located outside the Monument.

The wash in question is an active one, and floods regularly during times of adequate precipitation. Implementation of the selected alternative would therefore effect no long-term adverse impacts on soil, air or water quality or on wildlife or vegetation. There will be no impacts to any threatened or endangered plant or animal species, nor to any cultural resources.

Determination


Based on the analysis of the environmental assessment (attached), the selected alternative, as described in the Record of Decision above, would not have appreciable effects upon the environment. Therefore, this management action does not constitute a major federal action that would have significant impact on the human environment, and thus an environmental impact statement will not be prepared.



Superintendent, Death Valley National Monument

5 Aug 88

Date



Regional Director, Western Region

8/17/88

Date

ETING

ENVIRONMENTAL ASSESSMENT Scotty's Castle Stucco Restoration

1.0 Purpose and Need

The primary buildings within the jurisdiction of Scotty's Castle Historic District have exterior wall surfaces of stucco, much of which has deteriorated in the years since the buildings' construction. Largely due to a lack of masonry skills and funding, little has been done to repair this exterior stucco since 1970, when the NPS acquired these buildings. Restoration of the deteriorated stucco is long overdue.

Throughout the District, there exists a varied range of stucco colors (pigmented during mixing, not painted), aggregate coarseness and application techniques. For example, the Power House top coat is brown/grey in color, with a maximum aggregate size of 1/8" diameter and applied to simulate cut stone. Other buildings have a mottled two coat (cream and brown colors) application resembling weathered adobe, with the top coat requiring sand sieved through window screen.

Common to each of these buildings is the multi-colored aggregate which shows through at the stucco surface during trowel application. The color and size of this aggregate is an integral part of the visual color and texture of the finished stucco surface.

Research of 1920's construction correspondence/photos, as well as recent laboratory analysis, confirms that all exterior stucco aggregate was historically screened from Tie Canyon Wash. This wash is located west of the immediate Castle complex area. To ensure a reasonable color and texture duplication, it is imperative that this same material source be utilized for needed stucco repairs and replacement. It is highly unlikely that identical material colors and size ratios could be located outside the park at any cost.

2.0 Proposed Action/Affected Environment

Historically, gravel was extracted from the wash behind the gravel separator for screening and washing. Because there is no longer a readily available water source, the proposal is made to set up a small screening plant 1/8 mile up wash of the original site. At this location a live fire hydrant exists and the wash is crossed by an established gravel road.

This site location provides material closely matching that used during original construction as well as a ready source of water for washing (rinsing) the sorted material. Moreover, the overburden can be efficiently returned to the wash at this point.

The screening plant will be set in place at the outer edge of the wash with a front end loader. The loader will also be used to top load the plant's hopper, as well as receive screened material

from the holding bin below for transport to the stock pile location.

The wash in this area is largely devoid of vegetation due to yearly flooding.

3.0 Alternatives

3.1 No Action

Maintaining the status quo would allow further deterioration of the historic structures in the Scotty's Castle Historic District, and would place the National Park Service in non-compliance with the National Historic Preservation Act of 1966.

3.2 Obtain Aggregate Elsewhere

This is not a viable alternative, since aggregate obtained from a source other than the original wash would not duplicate the original material, and therefore would not be suitable for use in stucco repair.

3.3 Implement the Proposed Action

Construct the proposed gravel separator; remove and separate 10-12 cubic yards of gravel per year for use in stucco repair.

4.0 Environmental Impacts of the Alternatives

4.1 No Action

No environmental impacts.

4.2 Obtain Aggregate Elsewhere

No environmental impact.

4.3 Implement the Proposed Action

Implementation of the proposed action will have minimal adverse impact on the wash and surrounding area. Access to the site is from an existing road which cuts across the wash bottom. The proposed activity will take place approximately 50' downwash from this point.

At any one time up to 250' of the wash (approximate width 65') may be disturbed by the operation, which includes the storage piles of sorted material, the shaker, digging activities and cement mixer presence. Material to be processed will be skimmed from the wash surface using a front-end loader to a depth not exceeding 2'. Overburden resulting from screening will be returned to these depressions and back bladed out.

There will be no adverse impact on individuals of plant or animal

species, whether threatened, endangered or commonly found in the area. All activities including driving will take place on the existing Tie Canyon dump road or in the adjacent wash. Natural run-off and occasional flooding (at least once per year) in the wash prevents any permanent establishment or plant and animal residence and will obliterate signs of screening/washing activities. Wash banks will not be disturbed by any of the activity.

5.0 Archeological Considerations

Per telephone conversation with George Teague, Archeologist, WACC, on May 23, 1988, no formal clearance is required for this project. George is familiar with the Tie Canyon Wash Area in this proposal because of previous unrelated visits.

The key factors in his determination are:

1. The accessibility to the screening plant location from an existing dump site road which crosses the wash bottom, thereby obviating the need for vehicle movement across undisturbed areas.
2. The wash area affected by this proposal remains quite active, thereby minimizing the potential of any archeological evidence remaining in situ.

If concealed archeological resources are encountered during project activities, all necessary steps to protect them will be taken. Furthermore, the Cultural Resource Management Division, WRO will be notified immediately.

APPENDIX A

IMPACT/MITIGATION MATRIX

Park: Death Valley National Monument
Project: Scotty's Castle Stucco Restoration

IMPACT	PRESCRIBED MITIGATION AND RESPONSIBILITY
1. Alluvial material may be removed to a depth of 2 feet from approximately 1/4 acre of the wash in Tie Canyon.	1. After screening, the excess material will be returned to the disturbed areas of the wash and back bladed to approximate the original topography. Natural appearance and condition will be further enhanced by yearly flooding in the wash.
2. Some vegetation (rabbit-brush, <u>Chrysothamnus</u>) present in the wash may be removed by the operation.	2. Yearly flooding precludes establishment of any but disturbance species, so plants will re-establish in the wash following the next episode of flooding.



450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

August 15, 1988

cc:
Mulhern, WRO w/c inc.

DEATH VALLEY	
1	INDEPENDENT
	THE POWER
	CALL TO THE
	CONSTITUTION
2	OF RESOURCES
3	UNIT CRANER
	RECORDS
	WORLD
	THE NEW
	INFORMATION
	PROPERTY
	THE
4-4-2-106	



United States Department of the Interior

NATIONAL PARK SERVICE
DEATH VALLEY NATIONAL MONUMENT
DEATH VALLEY, CALIFORNIA 92328

IN REPLY REFER TO:

H3015

August 24, 1988

Memorandum

To: Regional Director, Western Region
Attention: Chief, Park Historic Preservation

From: Superintendent, DEVA

Subject: Triple X Form, Scottys Castle

Attached for review and concurrence is a Triple X Action of Preservation Maintenance concerning duplication of existing stucco aggregate, necessary to accomplish accurate stucco repairs.

Edwin L. Rothfuss
Superintendent, Death Valley

Attachment

cc: Chief Resources Management
Unit Manager, Scottys Castle

XXX

ASSESSMENT OF ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

(Attach continuation sheets as necessary)

This form is required for all actions that have the potential to affect historic properties.

A. Originating Office

WR: 634

1. Park: Death Valley National Monument
Death Valley Scotty Historic District
2. Description of proposed action:
 - ☐ Implementing action included in plan under PMOA
 - ☒ Other PMOA Action Preservation Maintenance
 - ☐ Action not under PMOA.
3. Explain why the action is needed: Action is needed for a source of sand and aggregate which matches that used originally, as well as, a preparation/staging area during stucco repairs.
4. Cultural resources affected by proposed action (name and LCS number, if applicable):
Tie Canyon Storage Area DEVA # SC-35 LCS # 56101
5. The proposed action will (Check as many as apply):
 - ☐ Destroy historic fabric.
 - ☐ Remove historic fabric.
 - ☐ Replace historic fabric in kind.
 - ☐ Replace missing historic fabric.
 - ☐ Add non historic elements to a historic structure.
 - ☐ Remove non historic elements from a historic structure.
 - ☐ Alter historic terrain, ground cover, or vegetation.
 - ☒ Introduce non historic elements (visible, audible, or atmospheric) into historic setting or environment.
 - ☐ Reintroduce historic elements in a historic setting or environment.
 - ☐ Remove historic elements from a historic environment.
 - ☐ Remove non historic elements from a historic environment.
 - ☐ Disturb, destroy, impair, or render inaccessible archeological (surface or subsurface) resources.
 - ☐ Possibly disturb presently unidentified archeological resources or historic fabric.
 - ☐ Incur gradual deterioration of historic fabric, terrain, or setting.
 - ☐ Other (Describe briefly):

Describe the indicated effect(s) concisely: See continuation sheet.

6. Identify supporting approved plan(s), comment and/or action thereon by Advisory Council on Historic Preservation, dates of ACHP action and NPS approval, and section(s) of the plan(s) pertaining to the action. If none, so state:

None

7. Identify relevant NPS management policies and guidelines:
DEVA General Management Plan (DRAFT) 1988.
NPS-28, Cultural Resource Management Guidelines, 06/25/88
8. Describe any measures planned to minimize or lessen the loss or impairment of historic fabric, setting, integrity, or data: See attached Categorical Exclusion, Finding of No Significant Impact and Environmental Assessment for Scottys Castle Stucco Restoration.
9. Identify supporting study data and date(s) of preparation (attach if feasible):
DEVA Categorical Exclusion - Scottys Stucco Restoration, 06/25/88. FONSI, 08/15/88.
Environmental Assessment for Scottys Castle Stucco Restoration, 08/15/88.
10. Prepared by: George A. Wright Title: Restoration Specialist
11. Signature of Park Superintendent: _____ Date: _____

Regional Cultural Resources Staff Review and Certification

1. The foregoing assessment is adequate; the proposed action is consistent with all applicable NPS management policies, standards, and guidelines reviewed and concurred in by the Advisory Council; and the proposal incorporates all feasible measures to minimize adverse effects to cultural resources.
2. The proposed action is authorized by a planning document or program reviewed and concurred in by the Advisory Council.

	Yes	No	N/A
(Negative certifications must be justified on attachments.)	1 <input type="checkbox"/>	<input type="checkbox"/>	
	2 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Regional Archeologist Date

<input type="checkbox"/> Energy Consultation Held	1 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Regional Historian Date

Regional Energy Coordinator	1 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Date	2 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Regional Historical Architect Date

	1 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2 <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Regional Curator Date

Additional requirements of the proposed action:

Regional Director Approval of Proposed Action including Additional Requirements

- ☐ The proposed action, including any additional requirements stated above, meets all conditions in B.1 and 2.

WASO Record

Assessment received and noted:

Associate Director,
Cultural Resources Management

Date

Continuation Sheet

XX Form

County Castle: Tie Canyon Wash Screening Plant

It is proposed to set up a long term, but easily removed screening plant, gravel/sand washing area and sized material stock pile location in Tie Canyon Wash. The one piece screening plant and steel storage bins will be set in place with a front end loader and left until stucco repairs are completed. A one yard capacity cement mixer will be pulled into the same area with a pick-up truck. This will be done periodically to wash the screened material, removing excess dirt and alkali. This site was selected for three reasons:

1. Tie Canyon Wash is the original source of stucco sand and aggregate.
2. This is the only wash area with running water readily available.
3. Access to this location can be accomplished without driving over undisturbed ground.

The equipment/stock pile location will be posted as off-limits and cordoned off with steel posts and brightly colored rope to discourage access by the public. Secured area will be approximately 25' x 100'.

The specific reason for this xxx submittal is the visual and audible intrusion of the near-by Tie Canyon Trail. Because no other wash location is so well suited to the needs of this project and use of Tie Canyon Trail by the public is relatively low... it is justifiable to introduce this temporary and reversible intrusion into the area. In fact, it would be quite practical to add another informative stop to the Tie Canyon Trail leaflet and promote the efforts of accurate historic preservation.

Note: The attached Categorical Exclusion, Environmental Assessment and FONSI provide additional detailed information.

L76

August 24, 1988

Memorandum

To: Environmental Impact Files

From: Superintendent, Death Valley National Monument

Subject: Categorical Exclusion - - Scottys Castle Stucco Restoration

PURPOSE AND NEED

The primary buildings within the jurisdiction of Scottys Castle Historic District have exterior wall surfaces of stucco. Little has been done to repair this exterior stucco since 1970, when the NPS acquired these buildings. This was largely due to a lack of masonry skills and funding. The time to deal with the existing deterioration is overdue.

Throughout the District, there is a varied range of stucco colors (pigmented during mixing, not painted), aggregate coarseness and application techniques. For example, the Power House top coat is brown/grey in color, with a maximum aggregate size of 1/8" diameter and applied to simulate cut stone. Other buildings have a mottled two coat (cream & brown colors) application resembling weathered adobe, with the top coat requiring sand sieved through window screen.

Common to each of these buildings is the multi-colored aggregate which shows through at the stucco surface during trowel application. The color and size of this aggregate is an integral part of the visual color and texture of the finished stucco surface.

Through research of 1920's construction correspondence/photos, as well as, recent laboratory analysis, it is confirmed that all exterior stucco aggregate was screened from Tie Canyon Wash. This wash is located west of the immediate Castle complex area. It is imperative that this same material source be utilized for needed stucco repairs and replacement to ensure a reasonable color and texture duplication. It is highly unlikely that identical material colors and size ratios could be located outside the park at any

cost.

PROPOSED ACTION/AFFECTED ENVIRONMENT

Historically gravel was extracted from the wash behind the gravel separator for screening and washing. Because there is no longer a readily available water source, the proposal is made to set up a small screening plant 1/8 mile up wash of the original site. At this location a live fire hydrant exists and the wash is crossed by an established gravel road.

This site location provides material closely matching that used during original construction, a ready source of water for washing (rinsing) the sorted material and the overburden can be efficiently returned to the wash.

The screening plant will be set in place at the outer edge of the wash with a front end loader. The loader will also be used to top load the plants hopper, as well as, receive screened material from the holding bin below for transport to the stock pile location.

PROJECT ENVIRONMENTAL IMPACT

Implementation of the proposed action will have no adverse impact on the wash or surrounding area. Access to the site is from an existing road which cuts across the wash bottom. It is within 50' down wash from this point where the proposed activity will take place.

Material to be processed will be skimmed from the wash surface using a front-end loader to a depth not exceeding 2'. Overburden resulting from screening will be returned to these depressions and back bladed out.

There will be no adverse impact on species of plant or animal, whether threatened, endangered, or commonly found in the area. All activities including driving will take place on the existing Tie Canyon dump road or in the adjacent wash. Natural run off and occasional flooding prevents any permanent establishment or plant and animal residence and will obliterate signs of screening/washing activities.

ARCHEOLOGICAL CONSIDERATIONS

Per telephone conversation with George Teague, Archeologist, WACC on May 23, 1988, no formal clearance is required in this situation. George is familiar with the Tie Canyon Wash Area in this proposal because of previous unrelated visits.

The key factors in his determination are:

1. The accessibility to the screening plant location from an existing dump site road which crosses the wash bottom, thereby elimination vehicle movement across undisturbed areas.
2. The wash area affected by this proposal remains quite active, thereby minimizing the potential of any archeological evidence.

If concealed archeological resources are encountered during project activities, all necessary steps to protect them will be taken. Furthermore. The Cultural Resource Management Division, WRU will be notified immediately.

CONCLUSIONS

Implementation of the proposed action will have no significant impact on the natural or human environment and does not involve unresolved conflicts of alternative uses of available resources. There are no reasonable alternatives other than no action which need to be evaluated.

The exemption of this project from the NEPA process is consistent with National Park Service Guidelines for Categorical Exclusions (516 DM 2.3 Appendix 1).

Prepared by:

George A. Vayla
Restoration Specialist

5/25/88
Date

Concur:

Jack Fields
Unit Manager

5/24/88
Date

Concur:

Peter J. Pauls
Environmental Specialist

5/26/88
Date

[Signature]
Superintendent

Death Valley National Monument

5/27/88
Date

Attachment

cc: Tom Mulhern, WRU
Jim Muddleston, WRU
George Teague, WACC



United States Department of the Interior

NATIONAL PARK SERVICE

DEATH VALLEY NATIONAL MONUMENT

DEATH VALLEY, CALIFORNIA 92328

IN REPLY REFER TO:

H3015

September 7, 1988

Memorandum

To: Regional Director, Western Region
Attn: Chief, Park Historic Preservation

From: Superintendent, DEVA

Subject: Triple-X-Forms, Death Valley Scottys Historic District (DVSHD)

Attached for review and concurrence is a "blanket" Triple-X Action of Preservation Maintenance concerning the two-color, simulated-adobe stucco found on the exterior of most buildings at DVSHD.

A second Triple-X Action is included which addresses Preservation Maintenance procedures required to repair the exterior stucco of the Power House. It was felt that the two situations differ enough to warrant separate compliance actions.

Attached "...supporting study data...,Item #9" is applicable to both assesment of actions submitted..

Edwin L. Rothfuss
Superintendent, Death Valley

Attachments

cc: Chief Resources Management
Unit Manager, Scottys Castle

XXX FORM

ASSESSMENT OF ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

(Attach continuation sheets as necessary)

This form is required for all actions that have the potential to affect historic properties.

A. Originating Office

WR: 634

1. Park: Death Valley National Monument, CA.
Death Valley Scottys Historic District
2. Description of proposed action: See continuation sheet
[] Implementing action included in plan under PMOA
[XX] Other PMOA Action Preservation Maintenance
[] Action not under PMOA.
3. Explain why the action is needed: See continuation sheet.
4. Cultural resources affected by proposed action (name and LCS number, if applicable):

See continuation sheet
5. The proposed action will (Check as many as apply):

☒ Destroy historic fabric.
☐ Remove historic fabric.
☒ Replace historic fabric in kind.
☒ Replace missing historic fabric.
☐ Add non historic elements to a historic structure.
☐ Remove non historic elements from a historic structure.
☐ Alter historic terrain, ground cover, or vegetation.
☐ Introduce non historic elements (visible, audible, or atmospheric) into historic setting or environment.
☐ Reintroduce historic elements in a historic setting or environment.
☐ Remove historic elements from a historic environment.
☐ Remove non historic elements from a historic environment.
☐ Disturb, destroy, impair, or render inaccessible archeological (surface or subsurface) resources.
☐ Possibly disturb presently unidentified archeological resources or historic fabric.
☐ Incur gradual deterioration of historic fabric, terrain, or setting.
☐ Other (Describe briefly):

Describe the indicated effect(s) concisely: See continuation sheet.
6. Identify supporting approved plan(s), comment and/or action thereon by Advisory Council on Historic Preservation, dates of ACHP action and NPS approval, and section(s) of the plan(s) pertaining to the action. If none, so state:

None.

7. Identify relevant NPS management policies and guidelines:
DEVA General Management Plan (proposed draft FY-88).
NPS-28. Cultural Resource Management Guidelines.
8. Describe any measures planned to minimize or lessen the loss or impairment of historic fabric, setting, integrity, or data: **See continuation sheet.**
9. Identify supporting study data and date(s) of preparation (attach if feasible):
See continuation sheet.

10. Prepared by: George A. Vayda Title: Restoration Specialist

11. Signature of Park Superintendent: [Signature] Date: 9/2/88

B. Regional Cultural Resources Staff Review and Certification

1. The foregoing assessment is adequate; the proposed action is consistent with all applicable NPS management policies, standards, and guidelines reviewed and concurred in by the Advisory Council; and the proposal incorporates all feasible measures to minimize adverse effects to cultural resources.
2. The proposed action is authorized by a planning document or program reviewed and concurred in by the Advisory Council.

		Yes	No	N/A
(Negative certifications must be justified on attachments.)	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Yes	No	N/A
[] Energy Consultation Held	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Yes	No	N/A
Regional Energy Coordinator	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Yes	No	N/A
	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[Signature] 9/16/88
Regional Archeologist Date

[Signature] 9/22/88
[Signature] 9/20/88
Regional Historian Date

[Signature] 9/16/88
Regional Historical Architect Date

[Signature] 9/16/88
Regional Curator Date

Additional requirements of the proposed action:

C. Regional Director Approval of Proposed Action including Additional Requirements

The proposed action, including any additional requirements stated above, meets all conditions in B.1 and 2.

9/21/88

[Signature]

D. WASO Record

Assessor received and noted:

Associate Director,
Cultural Resources Management

Date

Continuation Sheet

XXX Form

Scottys Castle - Exterior Stucco (Blanket XXX)

2. It is proposed that a long range project be undertaken to patch, reattach or replace existing exterior stucco, as required.
3. The existing stucco conditions not only create a neglected, run-down appearance, but also encourages continued accelerated deterioration. Large cracks or areas of missing stucco permit water to damage framed walls and rust metal lath. In the case of stucco over poured concrete, openings in the stucco surface can also be damaging. Water can become trapped between the two materials causing further stucco breakdown and delamination, especially if trapped moisture freezes.

Damaged and missing stucco is responsible for other problems. Rodents, birds and insects are permitted access to nest inside wood frame walls. Falling stucco can present a serious safety hazard to visitors and employees, as was the case with the Power House in recent years.

4. <u>Structure</u>	<u>DEVA #</u>	<u>LCS #</u>
Chimestower	SC-03	07613
Cook House	SC-06	07616
Comfort Station	SC-08	None
Gas House	SC-05	07615
Hacienda	SC-01	07612
Motel Unit - Garage	SC-07	07617
Scottys Castle & Annex	SC-02	00250
Stable	SC-11	07620
Scottys Cabin	SC-09	56095
Retaining Walls	(throughout the complex)	

5. The destruction of historic fabric during stucco repairs is unavoidable. Areas of loose, crumbly or badly cracked stucco must be removed, including badly rusted metal lath. A proper repair requires sound metal lath, scratch coat and brown coat, before applying the finish buff coat.

Replacement-in-kind efforts are of utmost importance. The exterior stucco color was obtained by adding masonry pigments during mixing, not after-the-fact painting (exceptions are Motel Unit, Scottys Cabin, Comfort Station and some retaining walls). This also means the aggregate colors show at the stucco surface and affect the final appearance. Based on laboratory analysis, on-site experimentation, specialists' advice and construction correspondence, all reasonable efforts are being made to duplicate the stucco mix & color, aggregate color & size and application techniques. In the case of the two painted buildings, a determination will be made as to "period" paint color and matched as closely as possible.

Replacement of missing historic fabric will be executed in the same manner as the replacement-in-kind described above. Areas of missing historic fabric (stucco) are adjacent to intact, representative examples of the same material color, texture and application technique. This eliminates guess work and ensures historically accurate replacement.

8. The following outlines measures to be taken to minimize the loss of historic fabric, integrity and data.
- A. Nearly all exterior stucco surfaces have been photographed and the remainder will be prior to start-up of repair work.
 - B. The only removal of existing stucco materials will be those which would jeopardize a solid, successful repair. The conditions which would warrant removal of original or existing fabric would be delaminated stucco, which cannot be reattached and areas of deterioration caused by improper mixing, curing or application of stucco. Also, Areas which have been improperly repaired, resulting in an eyesore or perpetuating continued deterioration and sections which have been shattered by impact, resulting in many small fractures, not suitable for surface repair. Areas determined to have rusted or poorly secured metal lath will be removed, as will deteriorated stucco caused by long term moisture presence (i.e. leaking swamp coolers, improper vegetation watering and increased grade levels holding moisture). Every effort will be made to retain existing fabric which does not fall into these categories.
 - C. Research and experimentation has approximated historic stucco mixes. Original aggregate source & size has been determined and addressed in previous compliance requests. Sand, lime and cement types/ratios have been determined and final experiments are on-going to determine appropriate finish coat colors. Color determination will take into account anticipated fading caused by weathering and UV light. Adjustments must also be made for existing variations from wall to wall and building to building. As this process is fine tuned, it is anticipated that 60 to 70 formula variations will be logged for perpetual use during future repairs. Racks will be build to expose these formula samples to actual weathering conditions and provide permanent base color data.
 - D. Some minor improvements will be made when appropriate, without causing a visual obtrusion. As inner wall framing is exposed, areas showing minor deterioration will be treated with an NPS approved wood preservative and wall cavities will be insulated with fiber glass batts backed with a vapor barrier. Galvanized chicken wire and blued steel diamond lath will be replaced with galvanized expanded metal lath in those areas which require the removal of these materials.
 - E. On-going written and photographic documentation will be kept to enable future identification of original fabric from NPS repairs. This information will also be useful for long term tracking of repair success rates, in turn providing data for adjustments in subsequent repair.
 - F. Representative samples of original stucco variations in color, application methods & mixes will be identified and accessioned into the Castle collection, as well as, stored informally on an as-needed basis in an historic preservation collection cabinet.

9. "Consultant" Tom Mulhern, Chief PHP, WRO. on-going since mid-1970's.
- "Consultant" Rick Borjes, Historical Architect, WRO, on-going since 1981.
- "Consultant" Pat Calhoun, Instructor, Ceramic Tile Institute. intermittent since 1970.
- "Experimentation" on-site by maintenance staff, intermittent since 1980.
- "Lab Analysis", Micro-Chem Laboratories, San Jose. Ca. April 13, 1984. (attached)
- "Lab Analysis", Wiss, Jannery, Elstner Assoc., Inc., Ca. July 1986. (attached)
- "Consultant" Jim Askins, Chief, WPTC Training Center, Williamsport, Md., March 29, 1982
- "Experimentation" on-site by preservation staff, on-going since March 1988.
- "Environmental Assessment and Finding of No Significant Impact" for Scottys Castle Stucco Restoration, August 17, 1988. (attached)
- "Historic Structures Condition Study", DEVA, 1980.

XXX FORM

ASSESSMENT OF ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

(Attach continuation sheets as necessary)

This form is required for all actions that have the potential to affect historic properties.

A. Originating Office

WR: 634

1. Park: Death Valley National Monument, CA.
Death Valley Scottys Historic District
 2. Description of proposed action: See continuation sheet
 - [] Implementing action included in plan under PMOA
 - [XX] Other PMOA Action Preservation Maintenance
 - [] Action not under PMOA.
 3. Explain why the action is needed: See continuation sheet.
 4. Cultural resources affected by proposed action (name and LCS number, if applicable):
Power House & Pavilion DEVA # SC-04 LCS # 07614
 5. The proposed action will (Check as many as apply):
 - XX Destroy historic fabric.
 - Remove historic fabric.
 - XX Replace historic fabric in kind.
 - XX Replace missing historic fabric.
 - Add non historic elements to a historic structure.
 - Remove non historic elements from a historic structure.
 - Alter historic terrain, ground cover, or vegetation.
 - Introduce non historic elements (visible, audible, or atmospheric) into historic setting or environment.
 - Reintroduce historic elements in a historic setting or environment.
 - Remove historic elements from a historic environment.
 - Remove non historic elements from a historic environment.
 - Disturb, destroy, impair, or render inaccessible archeological (surface or subsurface) resources.
 - Possibly disturb presently unidentified archeological resources or historic fabric.
 - Incur gradual deterioration of historic fabric, terrain, or setting.
 - Other (Describe briefly):
- Describe the indicated effect(s) concisely: See continuation sheet.
6. Identify supporting approved plan(s), comment and/or action thereon by Advisory Council on Historic Preservation, dates of ACHP action and NPS approval, and section(s) of the plan(s) pertaining to the action. If none, so state:

None

7. Identify relevant NPS management policies and guidelines:
DEVA General Management Plan (FY-88 proposed draft).
NPS-28, Cultural Resource Management Guidelines.
8. Describe any measures planned to minimize or lessen the loss or impairment of historic fabric, setting, integrity, or data: See continuation sheet.
9. Identify supporting study data and date(s) of preparation (attach if feasible):
See continuation sheet.

10. Prepared by: George D. Vayle Title: Restoration Specialist

11. Signature of Park Superintendent: [Signature] Date: 9-13-88

Regional Cultural Resources Staff Review and Certification

1. The foregoing assessment is adequate; the proposed action is consistent with all applicable NPS management policies, standards, and guidelines reviewed and concurred in by the Advisory Council; and the proposal incorporates all feasible measures to minimize adverse effects to cultural resources.
2. The proposed action is authorized by a planning document or program reviewed and concurred in by the Advisory Council.

		Yes	No	N/A
(Negative certifications must be justified on attachments.)	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Robert Kelly 9/22
Regional Archeologist Date

		Yes	No	N/A
[] Energy Consultation Held	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Robert S. Rame 9/22/88
Regional Historian Date

		Yes	No	N/A
Regional Energy Coordinator	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[Signature] 9/16/88
Regional Historical Architect Date

	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Kevin Ducklow 9/16/88
Regional Curator Date

Additional requirements of the proposed action:

Regional Director Approval of Proposed Action including Additional Requirements

- [] The proposed action, including any additional requirements stated above, meets all conditions in B.1 and 2.

9/23/88

[Signature]

WASO Record

Assessment received and noted:

Associate Director,
Cultural Resources Management

Date

Continuation Sheet

XXX Form

Scottys Castle - Exterior Stucco (Power House & Pavilion)

2. It is proposed that the delaminated exterior stucco on the Power House be reattached to the concrete substrate where ever possible, using a cement slurry. Delaminated stucco which can not be reattached will be removed and ALL missing stucco replaced with new applications closely matching the original fabric.
3. The action is needed because moisture & debris continue to get behind these loose veneer areas and that coupled with expansion/contraction stresses, causes more delamination. As these problem areas expand, loose stucco is more likely to fall and the general public, as well as, employees occupy the areas below.

In addition, the concrete walls have small cracks which, in some cases, are letting moisture reach reinforcing bar placed close to the surface. As this rebar scales, it is breaking off surface concrete. Once this happens the rate of self destruction increases. The reattachment of loose stucco where possible and the reapplication of missing stucco will act as a protective skin keeping moisture away from the rebar.

5. The destruction of historic fabric during stucco repairs is unavoidable. In order to solve existing problems already stated and to ensure good, sound, water tight repairs... fragile, crumbly or badly cracked stucco must be removed.

Areas having exposed rebar require adjacent concrete being chipped away, then all scale and rust removed from the rebar; followed by a rust inhibiting coating (such as fish oil base metal primer). The concrete surface can then be patched and stucco repairs made.

Replacement-in-kind efforts are of utmost importance. The exterior stucco color was obtained by adding masonry pigments during mixing, not after-the-fact painting. This means the aggregate colors show at the stucco surface and affect the final appearance. Based on laboratory analysis, on-site experimentation, specialists' advice and construction correspondence, all reasonable efforts are being made to duplicate the stucco mix & color, aggregate color & size and application techniques.

Replacement of missing historic fabric will be executed in the same manner as the replacement-in-kind described above. Areas of missing historic fabric (stucco) are adjacent to intact, representative examples of the same material color, texture and application technique. This eliminates guess work and ensures historically accurate replacement.

8. The following outlines measures to be taken to minimize the loss of historic fabric, integrity and data.
 - A. Nearly all exterior stucco surfaces have been photographed and the remainder will be prior to start-up of repair work.
 - B. The only removal of existing stucco materials will be those which would jeopardize a solid, successful repair. The conditions which would warrant removal of original or existing fabric would be delaminated stucco, which cannot be reattached and areas of deterioration caused by improper mixing, curing or application of stucco. Also, areas which have been improperly repaired, resulting in an eyesore or perpetuating continued deterioration and sections which have been shattered by impact, resulting in many small fractures, not suitable for surface repair. Deteriorated stucco caused by long term moisture presence (i.e. improper vegetation watering and increased grade levels holding moisture) will be removed. Every effort will be made to retain existing fabric which does not fall into these categories.
 - C. Research and experimentation has approximated historic stucco mixes. Original aggregate source & size has been determined and addressed in previous compliance requests. Sand, lime and cement types/ratios have been determined and final experiments are on-going to determine appropriate finish coat colors. Color determination will take into account anticipated fading caused by weathering and UV light. Color adjustments must also be made for existing variations from wall to wall. As this process is fine tuned, formula variations will be logged for perpetual use during future repairs. Racks will be build to expose these formula samples to actual weathering conditions and provide permanent base color data.
 - D. On-going written and photographic documentation will be kept to enable future identification of original fabric from NPS repairs. This information will also be useful for long term tracking of repair success/failure rates, in turn providing data for adjustments in subsequent repairs.
 - E. Representative samples of original stucco variations in color, application methods & mixes will be identified and accessioned into the Castle collection, as well as, stored informally on an as-needed basis in a historic preservation collection cabinet.

9. "Consultant" Tom Mulhern, Chief PHP, WRO, on-going since mid-1970's.
- "Consultant" Rick Borjes, Historical Architect, WRO, on-going since 1981.
- "Consultant" Pat Calhoun, Instructor, Ceramic Tile Institute, intermittent since 1970.
- "Experimentation" on-site by maintenance staff, intermittent since 1980.
- "Lab Analysis", Micro-Chem Laboratories, San Jose, Ca. April 13, 1984. (attached)
- "Lab Analysis", Wiss, Jannery, Elstner Assoc., Inc., Ca. July 1986. (attached)
- "Consultant" Jim Askins, Chief, WPTC Training Center, Williamsport, Md., March 29, 1982
- "Experimentation" on-site by preservation staff, on-going since March 1988.
- "Environmental Assessment and Finding of No Significant Impact" for Scottys Castle Stucco Restoration, August 17, 1988. (attached)
- "Historic Structures Condition Study", DEVA, 1980.

Micro-Chem Laboratories

349 Lincoln Avenue • San Jose, California 95126 • (408) 993-0998

13 April 1984

Death Valley National Monument
P.O. Box 569
Death Valley, CA 92328

Job No. C-180-84

Attn: Mr. John May

Re: Petrographic Examination of Stucco and Aggregate Samples
Scotty's Castle

In accordance with your written request of 5 April 1984, one sample each of stucco and "local" fine aggregate samples were evaluated by petrographic methods. The objectives of the evaluations were to compare the local aggregates with that of the aggregates within the submitted stucco sample and previously examined stucco materials (see report dated 8-9-83). In addition, it was requested that the possible presence of hydrated lime in the finish coat be ascertained.

Test Methods

Powder mounts of the local aggregate particles were prepared and examined with a polarizing light microscope to determine the mineralogy of the constituents. A thin section was prepared from a portion of the stucco materials and likewise examined.

Petrographic Examinations

1. The local aggregate sample consisted of a wide variety of aggregates which were similar in composition and size to aggregates within the previously examined stucco samples.
2. The aggregates within the brown and finish coats of the submitted stucco sample were also similar in composition to the local aggregates. However, the top size aggregate in the finish coat was approximately 0.5 mm compared to 3.0 mm in the brown coat.
3. The presence of hydrated lime could not be detected petrographically due to the presence of an intensely carbonated cement paste.

Summary of Findings

1. The brown coat in the submitted stucco sample appeared to be very similar in aggregate composition in comparison to the brown coat of the previously examined stucco materials. The aggregates in the

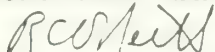
Death Valley National Monument
13 April 1984
Page 2

finish coats of the two stucco samples were dissimilar. "Local" aggregates were present in the finish coat of the submitted stucco whereas a quartz sand composed the previous stucco finish coat. The coarse particles (greater than 0.5 mm) in the local aggregate appeared to have been removed in the finish coat.

2. The hydrated lime content of the stucco could not be evaluated due to the alteration of the cement paste to calcium carbonate. However, the finish coat of the submitted stucco sample did not appear to be optically similar in composition to the finish coat of the previous sample which was believed to contain hydrated lime particles.

Respectfully Submitted,

MICRO-CHEM LABORATORIES



Robert C. O'Neill
Petrographer



Wiss, Janney, Elstner Associates, Inc.

CONSULTING AND RESEARCH ENGINEERS

2200 POWELL STREET SUITE 925

EMERYVILLE CA 94608 1836

(415) 428 2907



July 21, 1986

J M HANSON
J G STOCKBRIDGE
D W PEIFER
B BRESLER

J F WISS (1981)
J R JANNEY
R C ELSTNER

I P CHIN
R A CRIST
A T DERECHO
S A FREEMAN
C B MOON
W F PERENCHIO
E L PERRINE
P L POPOVIC
M K PRESTON
J F SEIDENSTICKER
S E THOMASEN
R E WEST
W E WHITE

T M BROWN
D W DENO
J FRACZEK
HENRY
IDING
KLEIN

W J KOOB
R J KRAUSE
J R LANDGREN
D L N LEE
P W LINEHAN
A LONGINOW
S L MARUSIN
D F MEINHEIT
W J NUGENT
J P STECICH
R H R TIDE
S D WERNER
G L ZWAYER

K J BEASLEY
G T BLAKE
W B CONEY
O E CURTH
L F ESTENSSORO
C S EWART
D K JOHNSON
H T LAFIN
R G LINDSTROM
W E MOORE
A N OSBORN
R A PLIGGE
R C REED
J D REINS
G P RENTSCHLEP
L REWERTS

Mr. Robert Haile
Exhibit Specialist, Scotty's Castle
National Park Service
Death Valley National Monument
Death Valley, CA 92328

Re: Scotty's Castle
WJE Job No. 860309

Dear Mr. Haile:

We have completed our laboratory analysis of the stucco samples you provided us from Scotty's Castle. I am enclosing three (3) copies of our laboratory report.

The purpose of the analysis was to identify the proportions of the materials and the color pigments in the finish coats. The samples from the building showed four stucco coats: two 1/16 inch thick finish coats, one brown and one scratch coat. The samples were tested by X-Ray diffraction, and by optical and scanning electron microscopy. In addition, an EDX analysis was made of the red spots in the buff finish coat. The following findings were made:

1. The composition of the mix is very rich and somewhat unusual. The recommendations for a mix design by Micro-Chem Laboratories are based on that we match the existing condition. We recommend that the amount of lime in the mix be reduced in order to minimize the potential for cracking. This is especially important when the mix is used for patching small areas.
2. The coloring agents in the mix consist of pigment rather than the natural color of the cement or the sand. The concentration and the proportion of the pigments vary greatly across the surface. This will have to be accounted for in the new design mix, because a mix that has the proper amount of pigment, but where the pigment is evenly distributed, will not provide a visual match.
3. The buff color of the top finish might originally have been the natural color of the cement. Such cement is generally no longer available. The buff color can probably be obtained by using an empirically determined level of finely ground, well-dispersed hematite, perhaps with TiO_2 as a diluent.
4. The bright red agglomerates are undispersed pigment particles. The pigment are nearly pure red hematite (Fe_2O_3).

Wiss, Janney, Elstner Associates, Inc.

National Park Service
Mr. Robert Haile

July 21, 1986
Page 2

It was the general opinion of the experts in the laboratory that the particular effect of the stucco at Scotty's Castle results not only from the particular mix of materials and pigments but also from the techniques used in the application of the stucco. For this reason they recommend the following:

1. The mix design be made by the Contractor that is selected to perform the actual installation.
2. The design of the mix using the original raw materials should be done by a skilled artisan working at the site. Consultations during the development of the mix can be made by contacting:

Ed Jakacki
USG Research Facilities
Libertyville, IL 60048
(312) 362-9797, ext. 212

3. Test panels should be made at the site to verify that the mix is compatible with the application technique.
4. Samples of the mix and samples of the test panels should be submitted to the laboratory for testing and verification.

I trust that these comments will help you in getting the project started. Please call me if you have any questions.

Very truly yours,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Sven E. Thomsen
Sven E. Thomsen
Senior Consultant

SET:msb

Enclosures (3)

APPENDIX K, LABORATORY TEST DATA ON STUCCO

Laboratories

349 Lincoln Avenue • San Jose, California 95126 • (408) 993-0998

30 March 1984

Death Valley National Monument
P.O. Box 569
Death Valley, CA 92328

Job No. C-176-84

ATTN: Mr. John B. May

Re: Analysis of Black Coating and Insulation Materials
EXTW, INTC, and Insulex Samples

In accordance with your written request of 24 March 1984, two samples of a "black coating" and a bulk insulation sample were received for microscopic examinations. The objectives of the examinations were to identify the constituents in each of the samples and to determine the asbestos content of the insulation sample.

Test Methods

Portions of the samples were mounted in a series of refractive index oils on glass slides and examined with a polarizing light microscope to determine the composition of the materials.


Test Results

1. The black coating in the EXTW and INTC samples consisted primarily of an asphalt-petroleum based material. Secondary amounts of calcite (CaCO_3) and cement mortar were also present in these samples.
2. The insulation sample contained no fibrous materials. No asbestos minerals were observed in this sample. The sample consisted of a mixture of calcite and crushed glass (perlite?) fragments.

Should any questions arise concerning the findings of this report, please contact the undersigned.

Respectfully Submitted,

MICRO-CHEM LABORATORIES


Robert C. O'Neill
Microscopist

UNITED STATES GOVERNMENT

memorandum

DATE WENDG 4/22/84

REPLY TO
ATTN OF ROBERT HAILE

SUBJECT STUCCO, AND CONSTRUCTION RESEARCH

TO JOHN MAY

All technical information accumulated from construction correspondence, various surface observations, and laboratory analysis was reviewed, and it was ascertained that adequate information was on hand to pursue the development of the scratch, and brown coats on the stucco test panels. Unfortunately all information on the pigments of the two finish coats has not yet been recieved, so these coats are to be further delayed.

On Tues. I went to Las Vegas to procure the proper sieve size of silica sand to be utilized in the finish stucco coats on the test panels. Also we recieved additional stucco analysis from Micro-Chem Laboratories confirming simularity of processed sand located at the gravel seperator, to aggregate used in the stucco scratch, and brown coats as well as confirming that local aggregate was added to a commercial stucco in the finish coat of the Power House.

Due to the seemingly unproffesional response, and in some cases lack of response, on stucco pigment duplication from the Conrad Sovig Co. I am currently pursuing this subject with the L. M. Scofield Co. of Los Angeles. Stucco samples, constituent analysis, and pictures of application techniques have been forwarded to them in anticipation of a response with in ten days. If all else fails, attached to this report is a breakdown of mineral pigments that would be required to conduct our own color experimentaion.

The formulas ascertained for scratch, brown, and finish coats are as follows:

Scratch, and brown coats: 1 part no. II Portland cement, 1 part autoclave lime, and 3 parts "local" sand.

Finish coats: 1 part White Portland cement, 1 part autoclave lime, and 3 parts no. 20 silica sand.

Power House finish coat: Substitute 1 part local sand for 1 part silica sand.

note: Autoclave lime has been substituted for hydrated lime as no presoaking is required. This double hydration has been accomplished by the manufacturer, other than that the materials are the same.

Bob Haile

4/21/84

BASIC COLORS REQUIRED FOR COLOR EXPERIMENTATION

White portland cement and #20 silica sand base 1:3 ratio

Brown = brown oxide of iron
modify with yellow oxide of iron

Buff = yellow oxide of iron
modify with red oxide of iron

Cream = yellow oxide of iron in small quantities

In lieu of:	Use:
brown oxide of iron	burnt umber
yellow oxide of iron	yellow ochre

FINAL STUCCO COLORS FOR EXPOSURE AND WEATHERING TEST

2-13-89

(Transcribed from handwritten data in park files).

TBS = tablespoon

tsp = teaspoon

Scoops are packed tightly and scraped level

D = Darker samples (were usually increased by 1/2 tsp to 1/2 oz.)

L = Lighter samples (were usually decreased by 1/2 tsp to 1/2 oz.)

Suggested mix for mixer: approx. 1 wheel barrow load

- | | | |
|----|-------------------------------|-------------------------------|
| A. | 5 x 3 lbs sand | = 15 lbs |
| | 5 x 1 lb grey portland | = 5 lbs |
| | 5 x 1 lb lime | = 5 lbs |
| | 5 x 1 oz & t tsp burnt umber | = 5 ozs & 5 tsp |
| | 1 TBS & 1/2 tsp lemon | = 5 TBS & 5/2 tsp |
| B. | 4 x 15 lbs sand | = 60 lbs sand |
| | 4 x 5 lbs cement | = 20 lbs of cement |
| | 4 x 5 lbs lime | = 20 lbs of lime |
| | 4 x 5 ozs & 5 tsp burnt umber | = 20 ozs & 20 tsp burnt umber |
| | 4 x 5 TBS & 5/2 tsp lemon | = 20 TBS & 10 tsp lemon |

* Note: All sand, cement, lime was done by weight, some coloring was not, final batch mix should be the total weight of tsp, TBS, etc.

Power House (Brown coat)

- | | |
|-----|------------------------------|
| #1 | 3 lbs sand |
| | 1 lb Portland grey |
| | 1 lb lime |
| | 1 oz & 1 tsp burnt umber |
| | 1 TBS lemon |
| #1D | 3 lbs sand |
| | 1 lb Portland grey |
| | 1 lb lime |
| | 1 oz & 1-1/2 tsp burnt umber |
| | 1 TBS & 1/2 tsp lemon |
| #1L | 3 lbs sand |
| | 1 lb Portland grey |
| | 1 lb lime |
| | 1 oz & 1/2 tsp burnt umber |
| | 2-1/2 tsp lemon |

#2 3 lbs sand
1 lb Portland grey
1 lb lime
1 oz & 1/2 tsp burnt umber
1 TBS & 1/4 tsp lemon

#2D 3 lbs sand
1 lb Portland grey
1 lb lime
1 oz & 1 tsp burnt umber
1 TBS & 3/4 tsp lemon

#2L 3 lbs sand
1 lb Portland grey
1 lb lime
1 oz burnt umber
2-3/4 tsp lemon

Cook House

Brown coat on east side

* use 1/8" sand for all brown coats

#3 3 lbs sand
1 lb Portland grey
1 lb lime
1-1/2 oz burnt umber

#3D 3 lbs sand
1 lb Portland grey
1 lb lime
2 oz burnt umber

#3L 3 lbs sand
1 lb Portland grey
1 lb lime
1 oz burnt umber

Bronze brown coat on south side of Cook House

* again use 1/8" sand

#4 3 lbs sand
1 lb Portland grey
1 lb lime
5 TBS burnt umber
1 TBS lemon
1/2 tsp red

#4D 3 lbs sand
1 lb Portland grey
1 lb lime
5 TBS & 1/2 tsp burnt umber
1 TBS & 1/2 tsp lemon
1 tsp red

#4L 3 lbs sand
1 lb Portland grey
1 lb lime
4 TBS & 2-1/2 tsp burnt umber
2-1/2 tsp lemon
1/2 tsp red

Buff coat on Cook House

* All buff or finish coats use #60 or finer Quartz sand
(bought commercially)

#5 3 lbs sand
1 lb white cement
1 lb lime
1-1/4 tsp burnt umber
1/4 tsp lemon

#5D 3 lbs sand
1 lb white cement
1 lb lime
1-1/2 tsp burnt umber
1/2 tsp lemon

#5L 3 lbs sand
1 lb white cement
1 lb lime
1 tsp burnt umber
1/4 tsp lemon

Stables

Buff coat * #60 grit silica sand

#6 3 lbs sand
1 lb white cement
1 lb lime
4 tsp burnt umber
1-1/2 tsp lemon

#6D 3 lbs sand
1 lb white cement
1 lb lime
4-1/4 tsp burnt umber
1-3/4 tsp lemon

#6L 3 lbs sand
1 lb white cement
1 lb lime
3-3/4 tsp burnt umber
1-1/4 tsp lemon

Brown coat on Stables
* use 1/8" sand

#7 3 lbs sand
1 lb Portland grey
1 lb lime
2 oz burnt umber

#7D 3 lbs sand
1 lb Portland grey
1 lb lime
2-1/2 oz burnt umber

#7L 3 lbs sand
1 lb Portland grey
1 lb lime
1-1/2 oz burnt umber

Retaining Wall by MPF near east end by gate
Buff coat * use #60 silica sand

#8 3 lbs sand
1 lb white cement
1 lb lime
4-1/2 tsp burnt umber
1-1/4 tsp lemon
1/4 tsp red

#8D 3 lbs sand
1 lb white cement
1 lb lime
5 tsp burnt umber
2 tsp lemon
1/4 tsp red

#8L 3 lbs sand
1 lb white cement
1 lb lime
4 tsp burnt umber
1 tsp lemon
1/8 tsp red

Aggregate

Notes: George Chapman, Mason

2-22-89

(Transcribed from handwritten park document).

Aggregate was obtained historically from Tie Canyon and sieved at the Gravel Separator.

I proposed designing and constructing our own screening plant to obtain desired aggregate sizes.

1. Historical samples of scratch coat show that the aggregate size is in the range of 3/16 of an inch.
2. Historical samples of the brown coat showed that the aggregate size was in the range of 1/8 inch.
3. Historical samples of the finish coat show pure Quartz sand (bought commercially) in some samples and in others a mixture of commercial Quartz and a finer than window screen sand from Tie Canyon. Aggregate size is approx. #60 grit. In research experiments completed thus far, #60 grit sand mixed with proper amount of coloring appear to be similar to existing finish coats on various structures of Scotty's Castle.

Ratio of Mix

1. Previous work experience in stucco mixes. A standard ratio 1:3 has been utilized; that is one cement, one lime and 3 sand. 1:4 ratio has been too lean and anything less than 1:3 has been too rich.

Some stucco contractors will use 1/2 less to 1/2 more of lime depending on workability preferences.

1. Grey Portland Type II used for scratch coat and some colors.
2. White cement Type II use for buff or finish colors.
3. Type S lime (special hydrated) used in all applications & mixes.

Colors

Original historical colors and special stucco mixes are no longer available. They were originally obtained thru Scofield in Los Angeles, CA.

I was able to obtain basic raw colors from Davis Colors of Los Angeles, CA.

Burnt umber
Raw umber
Lemon oxide
Red iron oxide

Colors are to be proportioned 5 to 7% of total wgt. of materials (sand, cement, lime) with colors experimentation thus far if is approx. 5% total wgt.

Texture

1. Scratch coat -- no concern, only requires horizontal scratches to provide key bond for brown coat.
2. Brown coat -- has vertical scratches 3/8" center to center. I constructed a scarifier to match historical tooling.
3. Finish coat -- must be with fine sand at least #60 grit or coat can not be finished or troweled smooth.

Laboratory Test Report:
Sieve Analysis of Coarse and Fine Aggregate
in Experimental Stucco Mixes for Restoration Work
May 31, 1989

This analysis found our stucco to be well washed of dirt and debris -- but low in fine aggregate size. Our test results are underlined.

(Note by George Voyta, 11/22/89)

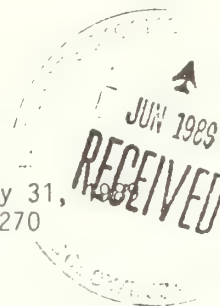


ETEC TESTING LABORATORIES, INC.

4150 W. Pioneer Ave., Suite A • Las Vegas, NV 89102
(702) 367-0100

CLIENT: Department of the Interior
National Park Service
Death Valley National Monument
Death Valley, California 92328
Attention: Mr. George Chapman

DATE: May 31, 1989
ETEC NO: 93270



PROJECT: Scotty's Castle
SAMPLE: Plaster Sand
DATE RECEIVED: 05-21-89

MARKED: Lab Analysis
SUBMITTED BY: NPS

REPORT OF DETERMINATION

SIEVE ANALYSIS OF COARSE AND FINE AGGREGATE
ASTM DESIGNATION: C117 - C136

Sieve Size	PERCENT FINER THAN EACH SIEVE BY DRY WEIGHT							Fineness Modulus
	#4	#8	#16	#30	#50	#100	#200	
	100	81	38	17	6	2	0.7	3.56
Spec*:	100	90-100	60-90	35-70	10-30	0-5		2.05 - 3.05

ORGANIC IMPURITIES IN FINE AGGREGATE FOR CONCRETE
ASTM DESIGNATION: C40

Less Than Organic Plate No. 1: Non-detrimental

NOTE: Recommended adding approximately 20% #30 or #50 sand to plaster sand to improve water retention capabilities and reduce sand to cement + lime volume to 2½:1.

* ASTM Designation: C897 Aggregate for Job-Mixed Portland Cement-Based Plasters

Respectfully submitted,

ETEC TESTING LABORATORIES, INC.

Daniel C. Thorne

and

Kulwant S. Sahi, P.E.

SOILS INVESTIGATION AND FOUNDATION ENGINEERING; CONCRETE AND MATERIAL CONSULTANTS;
MIX DESIGN SERVICES; TESTING SERVICES; TROUBLESHOOTING CONSULTANTS; NON-DESTRUCTIVE STEEL AND WELDING CERTIFICATION

Laboratory Test Report:
Compressive Strength
of Experimental Stucco Mixes for Restoration Work
and of Original Cook House Exterior Plaster
September 28, 1989

Underlined results from original stucco samples thought to be conservative because test cylinder was made up of "stacked discs" of original wall stucco.

Compressive strength of "cylindrical concrete" specimens which we submitted may be conservative because of some voids & question of proper curing. Will be resubmitted.

(Notes by George Voyta, 11/22/89)



ETEC TESTING LABORATORIES, INC.

4150 W. Pioneer Ave., Suite A • Las Vegas, NV 89102
(702) 367-0100

CLIENT: Department of the Interior
National Park Service
Death Valley National Monument
Death Valley, California 92328
Attn: Mr. George Voyta

DATE: 9-28-89
ETEC NO: 93270-1

PROJECT: Scotty's Castle-Death Valley, CA
SAMPLE: Exterior Portland Cement Plaster
DATE RECEIVED: 9-26-89

MARKED: See Below
SUBMITTED BY: NPS/George Voyta

REPORT OF DETERMINATION

TEST METHOD FOR COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS

ASTM DESIGNATION: C39

SAMPLE DESIGNATION	SPECIMEN SIZE	AREA, SQ. IN.	COMPRESSIVE STRENGTH		MIX PROPORTIONS
			POUNDS FORCE	psi	
9-6-89	2 x 4"	3.1416	5359	1710	3 Sand-1 Cement-1 Lime
9-6-89	2 x 4"	3.1416	4113	1310	3 Sand-1 Cement-3/4 Lime
9-7-89	2 x 4"	3.1416	8800	2800	3 Sand-1 Cement-1/10 Lime
8-7-89	2 x 4"	3.1416	9591	3050	2½ Sand-1 Cement-½ Lime

DATE TESTED 9-28-89

DRILLED CORES OF HARDENED PLASTER

SAMPLE

DESIGNATION: Original Cook House Exterior Plaster - 1928
Full Plaster Thickness-Including Expanded Metal Lath in Base Coat

SAMPLE NO.	A1	A2	A3	A4
DIAMETER, INCHES:	1.224	1.218	1.220	1.220
LENGTH BEFORE CAPPING, INCHES:	1.252	1.305	1.110	1.108
LENGTH AFTER CAPPING, INCHES:	1.400	1.500	1.260	1.108
CROSS SECTIONAL AREA, SQ. IN.:	1.173	1.165	1.169	1.169
MAXIMUM LOAD, POUNDS:	4050	3450	4930	4700
COMPRESSIVE STRENGTH, psi:	3450	2960	4190	4020
CORRECTED COMPRESSIVE STRENGTH, psi:	3150	2740	3700	3550
L/D RATIO:	1.14	1.23	1.03	1.04

Respectfully submitted,
ETEC TESTING LABORATORIES, INC.

By: Daniel C. Thorne
Daniel C. Thorne

and

Kulwant S. Sahi
Kulwant S. Sahi, P.E.

Transcription of handwritten notes by George Voyta concerning lab test results.

6/28/90

ETEC Testing Lab Results
of Las Vegas, NV

Scotty's Castle Preservation
P.O. #8130-0-0149
ETEC #93270

Following notes/comments are per phone conversation w/ Kulwant Sahi, Engineer at ETEC labs.

Test results, page 2, item #1 & 2
Compressive strength and hardness of 2x4 cylinders:

As stated, the work description of hardness is relative to the five sets tested. It is not intended to be a statement of acceptability. Tests of modern stucco by ETEC run about 2,000 to 2,500 psi.

Test results, page 3, item # 3
Adhesion Test:

Interesting to note that when adhesion results were good, efflorescence was relatively low and vis-versa.

Test results, page 5, item # 4 & 5
Gradation test for unwashed and washed sand:

It should be noted that during screening process both washed and unwashed samples were purged of, of least, some fine material, dust, etc. This was due to a squirrel cage blower set up to blow thru screened material after it passed thru sieve, then into front-end loader. Also, it should be noted that the samples are Tie Canyon wash material "before" spiking with silica sand, as recommended during previous ETEC testing.

These test results show that the 3/16" unwashed sample could probably be used as it is, meaning without spiking silica sand into it and without washing or with very little washing. The 1/8" washed sample is definitely short on the fines necessary for "inter-locking aggregate strength".

The #200 sieve size material was not tested to determine if the fine material is ground stone, clay or dirt.

Test results, page 5, item #6

Water suitability test for Castle water:

These results we[re] all quite acceptable with the exception of two items. The Ph factor was just over the top end of the range considered acceptable for masonry work. The other item of concern is total alkalinity, which coupled with modern cements (higher in alkali than used to be) is probably causing the efflorescence coating, some adhesion problems and a loss of compressive strength.

"Conclusions"

Because of tighter "EPA" pollution guidelines, less alkali can be discharged into the air during the manufacture of cement. So, the cement industry has increased the maximum, allowable amount of alkali permitted to remain in bagged cement. This coupled with the high alkali content of Castle water is causing a problem. One possibility is to purchase low alkali cement. This is considerably more expensive and difficult to obtain. The recommendation made by ETEC labs was to use distilled water for, at least, mixing stucco. If it were possible, to also use distilled water for all cure-wetting of stucco. This will take some research to find a total solution to the problem.

It was also suggested we scratch more deeply between stucco coats to improve mechanical bond. Efflorescence can be allowed to weather off (weeks to months) and may be hastened by suitable brushing with distilled water. In any case, it is a factor to be reckoned with.

[George Voyta]
Rest. Spec.



ETEC TESTING LABORATORIES, INC.

4150 W. Pioneer Ave., Suite A • Las Vegas, NV 89102
(702) 367-0100

Death Valley National Monument
Death Valley, CA 92328

June 11, 1990

Attn: Mr. George A. Voyta

Re: Scotty's Castle Preservation
P.O. No. PX 8130-0-0149

ETEC NO: 93270

As per your authorization we have performed the requested tests on the stucco samples and raw materials.

2 x 4" cylinders were fabricated by the client on October 3, 1989 and were marked as below:

Set No. 2: Proposed for 2nd coat application of the scratch coat.

Proportions Used:

3 Parts Sand (2 parts 3/16" tie wash sand and 1 part 50% mix of #60 and #20 Silica Sand)

1 Part Portland Cement Type I or II (Riverside Cement Co.)

3/4 Parts Lime (Type S)

Set No. 3: Proposed for 1st coat application of the scratch coat.

Proportions Used:

3 Parts Sand (2 parts 3/16" tie wash sand and 1 part 50% mix of #60 and #20 Silica Sand)

1 Part Portland Cement Type I or II (Riverside Cement Co.)

1/2 Part Lime (Type S).

Set No. 5: Proposed for finish coat application

Proportions Used:

3 Parts Sand (#60 Grit Silica Sand)

1 Part Portland Cement Type I or II (Riverside Cement Co.)

1 PART LIME (Type S)

Death Valley National Monument
Stucco Test Samples
Scotty's Castle Preservation

June 11, 1990
ETEC NO. 93270
Page 2

Set No. 6: Proposed for Brown Coat Application

Proportions Used:

3 $\frac{1}{4}$ Parts Sand (2 $\frac{1}{4}$ parts 1/8" tie wash sand and 1 part 50% mix of #60 and #20 Silica Sand)

1 Part Portland Cement Type I or II (Riverside Cement Co.)

1 Part Lime (Type S)

Set No. 9:

Proportions Used:

3 Parts Sand (2 parts 1/8" tie wash sand, 1 part 50% mix of #60 and #20 Silica Sand)

1 Part Portland Cement Type I or II (Riverside Cement Co.)

1 Part Lime (Type S)

1 & 2. Compressive Strength and Hardness of 2 x 4" Cylinders:

<u>Set No.</u>	<u>Compressive Strength, psi</u> <u>(Average of 3 Specimens)</u>	<u>Relative</u> <u>Hardness</u>
2	3330	Hard
3	3370	Harder
5	2090	Soft
6	2390	Soft
9	3050	Soft

3. Adhesion Test:

Six samples, marked as Sample A thru F were visually and mechanically analysed for adhesion between the scratch and brown coats.

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	<u>Adhesion</u>	<u>*Efflorescence</u>	<u>Hardness</u>
Sample A:	Poor	6	Soft
Sample B:	Excellent	1	Harder
Sample C:	V. Good	2	Hard
Sample D:	Good	3	Hard
Sample E:	Fair	5	Hard
Sample F:	Poor	4	Hard

*Rating 1 is the best of the samples and 6 is the worst of the samples.

Based on our evaluation, sample B has the best bond and appearance among the six samples submitted.

Samples identification as submitted by client is as below.

Sample A:

Brown Coat Application

3¼ Sand (2¼ parts tie wash sand 1/8", 1 part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-Omega Chemical mixed with mix instead of water.

Sample B:

Brown Coat Application

3¼ Sand (2¼ parts tie wash sand 1/8", 1 part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-Just H²O But Distilled

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Sample C:

Brown Coat Application

3½ Sand (2 parts tie wash sand 1/8", 1½ part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-Just Castle water

Sample D:

Brown Coat Application

3½ Sand (2½ parts tie wash sand 1/8", 1 part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-Just Castle water

Sample E:

Brown Coat Application

3½ Sand (2½ parts tie wash sand 1/8", 1 part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-Slurry or dash coat (3 parts #60 Silica and 1 part cement using castle water)

Sample F:

Brown Coat Application

3½ Sand (2½ parts tie wash sand 1/8", 1 part 50% mix of #60 and #20 Silica)

1 Cement (Portland Type I or II)

1 Lime (Type S)

Bonder-½ cup of Omega mixed with a semi wet mix using castle water

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NOTE-All samples were submerged in water for 28 days curing time, bases were made 12/89 by George Chapman.

4 & 5. Gradation Test for 3/16" Unwashed and 1/8" Washed Sand:

<u>Percent Passing by Dry Weight</u>							
Sieve Size:	<u>No. 4</u>	<u>No. 8</u>	<u>No. 16</u>	<u>No. 30</u>	<u>No. 50</u>	<u>No. 100</u>	<u>No. 200</u>
3/16" Unwashed							
Sand:	100	84	48	30	19	12	7.7
1/8" Washed							
Sand:	100	100	77	37	15	4	0.6

6. Water Suitability Test for Castle Water:

Water Quality Analysis:

Electrical Conductivity	696 umhos/cm
Resistivity	1440 ohm-cm
Total Dissolved Solids, calc.	487 mg/L
Total Suspended Solids	0 mg/L
Sodium	146 mg/L
Potassium	4 mg/L
pH	8.56 pH units
Flouride	1.80 mg/L
Nitrate-Nitrogen	0.80 mg/L
Sulfate	88 mg/L
Chloride	45 mg/L
Bicarbonate	218 mg/L
Carbonate	5 mg/L
Total Alkalinity, as CaCO ³	188 mg/L

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Soluble Sulfates in Sand Samples:

3/16" Unwashed Sand	0.009%
1/8" Wash Sand	0.006%


Based on our evaluation and information provided, it is our opinion that most of the efflorescence is caused by the presence of alkalies in the Castle water and the Portland Cement. We recommend that distilled water be used to minimize the efflorescence problem. For better bond between the scratch and brown coat, the scratch coat surface shall be clean, free from efflorescence, sufficiently damp and rough.

We trust this provides you with the information you requested. Should you have any questions concerning this matter, please feel free to call us.

Respectfully submitted,
ETEC TESTING LABORATORIES, INC.


Daniel C. Thorne

and


Kulwant S. Sahi, P.E.

APPENDIX L, EXCERPTS FROM HISTORIC CORRESPONDENCE PERTAINING TO TILE

The excerpts are from letters copied from the historical document collection at Scotty's Castle and compiled in a notebook file about 1972 by Denver Service Center personnel for research at that time, as indicated in a note by Susan Buchel, dated November 7, 1984. Presumably the file does not include all the letters. She indicates the complete group of documents are in manuscript collections (MSS) 5, 6, 7, 9, 10 and 12. The notebook file is listed in the Scotty's Castle library as No. 979.487 N, Acc. #898.

Most of the letters in the file are correspondence between Matt Roy Thompson and Albert M. Johnson. A few are from or to MacNeilledge. The notebook file begins with January 12, 1926 and ends at December 30, 1930.

Letters between MacNeilledge and Johnson or Thompson are from a "Main House/Annex Chronology", DEVA, SC Unit, unfinished research, undated, in "vertical files".

C. A. McNeilledge to A. M. Johnson, January 31, 1927:

All the building plans have been revised and are on the job....All the floor tile, exterior tile, and ornamental tile have been ordered. They are all hand made and require about two months to make. I am sure you will agree with me they are most unusual. [MSS 5, file 1.] [Refers to Lower Music Room as living room or small living room.]

MacNeilledge to Johnson, February 25, 1927:

I want to talk with you about putting a pitched roof on main building which will look much better having the center higher than the ends with a slightly different pitch on the ends with a good overhang on the sides. This will tie in much better with the Guest House. I would have suggested it before, but I did not expect we would tear out so much. All that remains now is the framing of the parapet on the two ends, so it could be easily changed. [MSS 5, file 1.]

MacNeilledge to Johnson, March 1, 1927:

I am sending a new sketch of the west view of the house which will convey how the building will look. You will note I have changed the roof to tile with a low pitch and broken height in center. I think you will agree that it is more pleasing and typical of the Spanish, also ties in better with the guest house. [MSS 5, file 1.]

Johnson to MacNeilledge, March 2, 1927:

I note your comment as to tile roof on the main house instead of a flat roof. I would suggest that you go ahead and design the tile roof, giving me a little sketch as to how same will appear, and I will take it up with you when I come out. [MSS 5, file 1.]

Johnson to MacNeilledge, March 12, 1927:

I shall be glad to have you go ahead with the new roof as shown in sketch. [MSS 5, file 1.]

MacNeilledge to Johnson, April 20, 1927:

I am mailing today blue prints of Bridge detail. Please let me have your comments on it as soon as possible so that I may include the tile for it with that already ordered. It takes four to six weeks to make and it should be shipped in car load lots.

I think you will find everything explained on the plan, and I am sure it will be a very attractive feature of the lake. [MSS 5, file 1.]

Johnson to MacNeilledge, April 29, 1927:

I am in receipt of your blue print showing bridge. It looks very pretty. I do not suppose, however, that you will get at that until I come out, as there is plenty of work on the house and two guest houses to keep everybody busy. [MSS 5, file 1.]

Thompson to Johnson, May 11, 1927:

Insulex has now been poured over the entire roof of the main house, and we are preparing to lay the roofing tile. The rafters are all in place so that the finished roof lines are visible. [Page 1, paragraph 2.]

Thompson to Johnson, May 14, 1927:

The freight is piling up at Bonnie Clare, mostly tiling, roof tile, cement and hay. [Page 1, paragraph 2.]

Thompson to Johnson, May 16, 1927 ("Monday a.m.")

The beamed ceiling is finished in Scott's room; also in your bedroom and the kitchen; and the one in the solarium is being put in place. They all look very fine. The fire place in the kitchenette is about built, also the one in the living room next to the solarium and they are beginning on the one upstairs in the west apartment. The plumbing is all in for the second story of the house, that is, roughed in, but the fixtures not set. Insulex is poured in the partitions in the west apartment and part in your apartment except around bathrooms and closets. Access will be left through the walls to all plumbing connections as formerly and insulex will be left out at those places. [Page 1, paragraph 1.]

The demurrage cars contained roofing tile packed in sawdust and it was very slow work handling same without breakage. [Page 1, paragraph 2.]

Thompson to Johnson, May 23, 1927:

Tiling is to the roof line on south side of house. The Solarium roof is built ready for roof tile. No roof tile has yet been palced [sic] anywhere but the main house is all ready for it. We will start on that work verysoon [sic]. [Page 1, paragraph 2.]

C. Alexander MacNeilledge to Matt Roy Thompson, September 21, 1927:

[MacNeilledge had hired roof tile setters and were to leave L.A. by auto the Friday following the date of the letter. Handwritten note on letter indicates they were Russell Hayes and D. V. Buttress, and they arrived on Sept. 25.]

Wages \$7.00 and board, expenses one way if they stay until completion of work, or as far as they can go. I want to get the tile on the roof and out of the way as soon as possible to make room for future shipments.

Floor tile setters, Joseph Forcella [sic] and Geo. W. Huchett will arrive on Friday train, wages \$10.00 and board, fare one way refunded if work satisfactory, and they stay three months. Also two helpers wages \$5.00 and board with same arrangement of fare. [Handwritten note on letter indicates helpers were Vern Antis and M. E. Quigg.]

The plasterers won't have much to do on the interior until the tile base is set. They cannot go on with the outside until I come up. Am working on some samples of texture here.

It will be about the first of the month before I can get on the job, so if we can get the base in place, the plasterers could go on with the walls.

C. A. McNeilledge to A. M. Johnson, September 23, 1927:

I have sent up five carpenters, two roof tile men, two floor tile setters, two plasterers, steamfitter and helper, which will be enough to start the work [presumably start-up of 1927-28 period]. [MSS 5, file 1.]

Thompson to Johnson, September 23, 1927:

One car of lumber and a car of tile came today. [Page 1, paragraph 6.]

Thompson to Johnson, October 2, 1927:

The plastering of the Kitchenette is now finished and we have begun laying the floor tile. It should be ready for occupancy in a few days. The two cabinets are all that remain to be done after the floor is laid. It looks very beautiful. I took some pictures of it today and will send same to you in about a week. [Page 1, paragraph 1.]

We are getting ready to pour up-stairs floor. The steel wire-meash [sic] reinforcing has come and is being laid ready for the concrete. The tiling is in in both bathrooms, except the floor tile which will be laid after the concrete is in. [Regarding the Main House? Page 1, paragraph 7.]

Thompson to Johnson, October 5, 1927:

The steel has arrived; two cars of lumber, a car of stucco, two cars of tiling, and many less than carload lots of freight. I will order cement in time to keep the trucks busy, and Mr. MacNeilledge is holding back some lumber and tile shipments so as not to crowd the trucks. [Page 1, paragraph 2.]

Thompson to Johnson, October 8, 1927:

Replying to your letter of October 3rd from New York: we will have both the Kitchenette and your upstairs apartment ready for occupancy by October 25 or very shortly thereafter, as well as the library and the main kitchen. All of the plate glass is in every window in the main house and annex.

I am enclosing some pictures taken last Sunday showing the building and the inside of the kitchenette, the fireplace and sink. [Page 1, paragraphs 1 and 2.]

We poured the concrete floor yesterday in your up-stairs apartment, and the plasterers will go ahead very soon with the finish coat. The tiling is in place in the bathrooms. We used very heavy wire mesh reinforcing in the floor to prevent any cracks from occurring which would have cracked the tile floors. The reinforcing mesh will of course cause all contraction and expansion movement to occur at the wall lines under the base tile or back of it instead of in the middle of the room. We have enough reinforcing mesh for all concrete floors that are to be laid over wood floors, and the slabs of concrete are to be not less than 1-1/2" to 2" thick for necessary strength. [Page 1, paragraph 6.]

C. A. McNeilledge to A. M. Johnson, October 11, 1927:

I think you can have your apartment by the 25th. They are starting the tile base and floor, and the plastering should be finished by the 25th. Mrs. Johnson's kitchen is all tiled. The cabinets and tables are built so I am sure her quarters will be ready. The glass is all in, also screens. [MSS 5, file 1.]

It will be necessary to increase the force to complete the main building by the first of the year.

MacNeilledge to E. Devlin [Johnson's secretary], October 12, 1927:

[Letter regarding payments, including:] The Gladding McBean bills, #D64139 -- \$42.63, D04150 -- \$99.04, D04142 -- \$803.78, D4141 --\$21.93, D04140 -- \$8.99, are all o.k. for payment. They have passed a credit of \$29.16, a mistake in addition on bill amounting to \$700.51. The date and number did not copy on my duplicate, but I think it was Oct. 19 or 20th.

Thompson to Johnson, October 13, 1927:

We are beginning this morning to set the tile base in your up-stairs apartment. The concrete floor in the west apartment was poured day before yesterday. [Page 1, paragraph 1.]

The Kitchenette is finished, except for the two cabinets which are being build [sic] and will be installed in a few days. The rooms look beautiful. Tile floor has been laid in the toilet and little shower-room, and the walls finished with white Keene cement. [Page 1, paragraph 5.]

C. A. McNeilledge to A. M. Johnson, October 17, 1927:

Mrs. Johnson's quarters will be ready to use by the 22nd, but your apartment will not have the floor laid until the 29th....The tile will be shipped tomorrow. [MSS 5, file 1.]

Thompson to Johnson, October 19 [?], 1927:

The concrete floor on the balcony in the main house was poured a few days ago. This finished the concrete floors upstairs in the main house. We are waiting for the floor tile for your apartment which I understand Mr. MacNeilledge is shipping this week. As soon

as it arrives the floors will be laid in your rooms and they will then be ready for occupancy. The kitchenette is finished and the plumbing installed in the bathroom and shower back of it. [Page 1, paragraph 2.]

A. M. Johnson to C. A. McNeilledge, October 24, 1927 [5//1]:

I understand from Mr. Thompson that the concrete has been poured on the balcony in the main house and all the concrete floors are finished but the floor tile for my apartment has not yet arrived. I am very anxious that this apartment be finished when I come out.

Please drop me a line by air mail upon receipt of this letter as to whether you have actually shipped the tile and as to when you expect the apartment to be finished.

I note from Mr. Thompson's letter that the kitchenette is finished, for which I am very glad.

Thompson to Johnson, October 27, 1927:

Replying to your letter of the 24th, it is quite certain that your apartment will be entirely completed by the time you arrive early in November. The floor tile came Sunday the 23rd and enough was hauled to camp by Tuesday to begin laying the floor. The bedroom, closet, and bath are already laid but not pointed up yet, and the living room will be laid very soon. [Page 1, paragraph 1.]

Thompson to Johnson, November 2, 1927:

Tiling will all be down in your upstairs apartment by tonight but it will take a few days to point it up. The bed and bath rooms are finished and the men are working on the living room which is nearly done. [Page 1, paragraph 2.]

C. A. McNeilledge to A. M. Johnson, November 8, 1927:

About two thirds of this main building has the final stucco finish, also part of the Annex....Your apartment is finished by now, also Mrs. Johnson's quarters....They are starting on the music room walls except the north which requires a little more rock removed. [MSS 5, file 1.]

C. A. McNeilledge to Devlin [Johnson's secretary], November 21, 1927:

The bill from Western Metal Crafts Co. is O.K. Also bill from Spanish Pottery. [MSS 5, file 1.]

Johnson to Thompson, December 19, 1927:

I also instructed Mr. McNeillidge [sic] to order 2,000 feet of 6" Vitrified tile with bell ends and 100 feet of 10" Vitrified tile with bell ends, from the Gladding McBean Company, as they made me the same price as you had from the Pacific Clay Products, together with a 5% discount from the factory price. [Page 1, paragraph 6.]

Thompson to Johnson, December 20, 1927:

Mr. Belleville's trucks are again on the job and with Mr. Merchant's truck also hauling cement it relieves our own trucks for hauling iron, tile, lumber, etc., and also to do the local hauling of sand and gravel here at the Camp....Cement is coming in at the rate of two cars a week. [Page 1, paragraph 1.]

Tile setters are setting the base in the living hall, and the floor in the old laundry room. [Page 1, paragraph 4.]

All excavation is finished for the music room and blower room and forms will be begun tomorrow. I will see that the necessary conduits are placed for the Deagan Chimes as per blue print which you gave me. The chimes came a few days ago and have been stored in the depot awaiting room for them here. We will put them in the old laundry room after the tile has set enough as that seems to be the safest and most accessible place. [Page 2, paragraph 4.]

Thompson to Johnson, December 27, 1927:

P.S. Tile setters laying west apartment floor and Scott's room and old laundry room, also fountain in Solarium. Plasterers half finished with main living hall, which will look magnificent. Too cold for out door tiling or plastering.

Thompson to Johnson, January 8, 1928:

Plasterers have finished new barn, and are working in living hall on the railing and other special features. Tile setters have laid tile in living room of annex but not pointed it up yet. They are pointing up the gallery tile. Roofers...are also laying tile roof over bay window of library. [Page 1, paragraph 2.]

Johnson to Thompson, January 12, 1928. Concerning a closet for the Annex Italian Room, Johnson wrote:

It seems to me it would be very highly desirable, if possible, to put a closet in that would be accessible to the west room over Mrs. Johnson's kitchenette. This closet might be placed on the outside north wall, just west of the piping and ventilating shaft, the entrance to the room being either through an extra door or through that window. Think this over, and if anything occurs to you that might be worked in, drop me a sketch. Talk it over with Mr. MacNeilledge the next time you see him, and also with Mr. Brown, to see if something can be worked out to get as closet for that room, if possible. I do not think it practicable to cut any space out for it, as the tiling is all in. I think we might work out a closet out of a little alcove at the west end of the hall, just outside the bathroom door. [Page 1, paragraph 3.] [Also see letter of January 18, 1928.]

Johnson to Thompson, January 14, 1928:

Please advise me as to whether the tile has been laid in Scott's room, east and west porches, west apartment upstairs, and second floor gallery in main house, in living hall.

Has the tile been laid on the bridge, or in the two small bedrooms over in the guest house? [Page 1, paragraphs 2 and 3.]

Thompson to Johnson, January 14, 1928:

All plastering is now finished in the main house, and all tile floors laid except the living hall which was started today. The fireplace and chimney look fine. The two plasterers are now working on the bridge between the main house and the guest house. The music room is framed except its roof. Footings have been poured for the music room tower and arches east of the annex, and forms are being set for same. The arches and tower are to be of concrete. The two roofers have caught up with the carpentry work and one of them has begun helping the tile setters who were short handed. [Page 1, paragraph 1.]

Thompson to Johnson, January 22, 1928:

Replying to your letter of the 14th: All tile has been laid in every place in the main house except about seventeen tiles in the living hall which will have to be shipped up from Los Angeles. The tile setters are pointing up the living hall and will finish that room in two or three days except the 17 tiles referred to. This will finish the main house except the fountains in the living hall and solarium which will require special treatment where the water drips down the walls; and except the tower stairway, rails along north and south balconies in the living hall; and fixtures, mantles, hardware, etc. The bridge has not yet been tiled, nor the walkway around the annex on top of the old commissary. In fact there has been no tiling in the annex rooms except the living room over the kitchenette, but they are all ready for tiling, except of course the music room. [Page 1, paragraph 1.]

The music room roof is being framed. The tower at the music room is being formed for pouring its concrete walls. The parapet around the south side of the music room has been poured and tile cap is being placed. [Page 1, paragraph 6.]

Thompson to Johnson, January 29, 1928:

All tiling of the main house is finished except pointing up the west porch and the 16 missing tile in the living hall, and the stairway risers, and a few odds and ends that have to wait for one reason or another. The tile setters are laying the annex bath room tile, and will finish one of the bedrooms the hall, and part of the passageway in the annex this week and then lay off until they are needed again....We will probably lay the tile on the walkway south and west of the big room of the annex. [Page 1, paragraph 5.]

Thompson to Johnson, February 2, 1928:

The west apartment is now ready including the bath room. Scott's room is finished but the toilet and bowl are not yet in. They will be set in a few days. [Page 1, paragraph 3.]

Of course the east bedroom in the annex could be finished up immediately if you desire, but it might be better to wait until the closet scheme is finally decided upon. [Page 1, paragraph 5.] [See also paragraph 1 of that letter regarding the east bedroom of the annex. There was discussion of modifications between the east bedroom and the music room for the closet and a sleeping porch, relating to the slab over the blower room.]

Johnson to Thompson, February 2, 1928:

Has the old laundry been tiled and have the windows been put in? [Page 1, paragraph 4.]

Thompson to Johnson, February 12, 1928:

Replying to your letter of the 2nd, the old laundry room has been tiled and one window has been set. [Page 1, paragraph 1.]

Thompson to Johnson, September 14, 1928:

Mr. Brown is setting tile in the two bathrooms in the Guest House with one helper, a \$3 a day man. There is plenty to keep him busy for several weeks, at least until November 1st. [Page 1, paragraph 2.]

Thompson to Johnson, November 7, 1928:

Well it seems that our old class-mate got elected all right. He will make a good president I am sure. The returns came in clear last night. I suppose you were also listening to them. [Page 1, paragraph 1.]

Tile setters are setting the floor tile in the east room of the guest house and will work west through the building....He also has set the four radiators in the music room. We are today running the channel tile from the power room to the basement under Scott's room diagonally for organ and chimes conduits etc. [Page 1, paragraph 4.]

Thompson to Johnson, December 18, 1928:

It is too cold to do outdoor tile setting, so the tile men will lay off next Saturday until warmer weather as they will have all indoor tile laid by that time, except the music room which cannot be laid until electric conduits are in place which are now waiting for a special pull-box designed by the organ men, which has been ordered. It would probably not be safe to lay the concrete floor in the music room until weather is more favorable. One tile setter is finishing the fountain in the living hall. [Page 1, paragraph 2.]

Thompson to Johnson, January 1, 1929:

Painters are finishing your bedroom and cabinet. Kitchenette and main kitchen and Scott's room have all been finished. Main fountain is finished in living hall and looks fine. Tile is all set for solarium fountain except the top margin where the copper trough and pipes are located. [Page 1, paragraph 5.]

Thompson to Johnson, January 20, 1929:

All organ and console conduits in the music room are in place, and the concrete floor can now be poured. Mr. Brown expects to get at this very soon. [Page 1, paragraph 3.]

The tile on the porch of the guest house is nearly all laid. Carpenters are forming the stairway walls behind the guest house. [Was the Annex still being called the guest house?] [Page 1, paragraph 5.]

Thompson to Johnson, February 10, 1929:

It has been too cold to do any plastering or roof tiling. [Page 1, paragraph 1.]

Thompson to Johnson, February 15, 1929:

The tile men are laying the floor in the music room. [Page 2, paragraph 2.]

The walls of the new patio tunnel were poured yesterday and today. The porch floor at the east end of the annex has been poured and is ready for tile. [Page 2, paragraph 6.]

Thompson to Johnson, February 20, 1929:

The tile layers are laying floor in the music room. It is about half done, and looks very beautiful. All the tile has been laid in the guest house except the west end of the porch and some miscellaneous places where additional tile will have to be waited for. I suppose Mr. MacNeilledge has ordered these. [Page 1, paragraph 4.]

Thompson to Johnson, February 24, 1929:

We poured the roof of the tunnel west of the patio yesterday. That part inside the patio will wait until the whole width of the patio can be paved to avoid a cold joint that would cause a crack. [Page 1, paragraph 2.]

Thompson to Johnson, February 26, 1929:

Tile is laid on the guest house porch except the west end which is waiting for more tile. [Page 1, paragraph 3.]

Johnson to Thompson, February 26, 1929:

From what you tell me regarding the tile, I presume by the time this letter reaches you the tile will have been laid everywhere with the exception of the large patio between the main house and the annex. [Page 1, paragraph 5.]

Thompson to Johnson, March 3, 1929:

Am enclosing four long photos and 5 short ones taken February 22 and 24, 1929, showing condition of work on those dates. [Page 1, paragraph 1.]

Tile layers are still working on the music room floor. [Page 1, paragraph 5.]

Thompson to Johnson, March 6, 1929:

Tiling is yet to be laid in the lanas [sic] and around the music room; also in the patio and stairways leading to the basement; and in the annex garage; (The shop will be just cement floor per Mr. MacNeilledge's orders.) Also there are a few places in the guest house to be tiled as soon as the new tile arrives. And the top floor of the chimes tower is to be tiled. Then there will be some tile walks, etc., around the main house. [Page 2, Item 4.]

The Indians have been digging out the planting beds in the patio, which is quite a job as it is mostly solid rock. We are using 3" Byers galvanized pipe for drain for these planting pockets, thoroughly tarring same. [Page 2, Item 12.]

Thompson to Johnson, March 10, 1929:

Tile setters are still working on the floor of the music room, and beginning in the lanas [sic] and the walk around the music room. [Page 1, Item 4.]

Indians are chiseling out the flower beds along the north wall of the patio. [Page 1, Item 6.]

Mr. MacNeilledge asked me to work out sundial problem for face of music room. I took an observation on polaris...will send template...to Mr. MacNeilledge for tile design. [Page 1, Item 9.]

Thompson to Johnson, March 14, 1929:

The planting beds in the west half of the patio have been concreted and we are now getting ready to pave the west half of the patio in preparation for laying the tile. [Page 1, Item 1.]

SUN DIAL. We have the model of the sun dial in place on the chimney of the music room and I today marked all hour positions very carefully. [Page 2, Item 6.]

TILE SETTING. Tile men are laying the lanas [sic] floor and the walk around the music room. Also putting the finishing touches on the music room floor. The fountain for the lanas will be set in place soon. We have extended the water and drain pipes to its location, but do not yet know just how the water is to be fed to the fountain. There are four porcelain frogs to mount on the four corners of the basin, and it would appear that the water is to come through the mouths of these frogs. We will wait until hearing from Mr. MacNeilledge before installing same. [Page 2, Item 8.]

Drain pipes have been put in under the planting beds in the west half of the patio and are being placed in those in the east half. [Page 3, Item 10.]

Johnson to Thompson, March 14, 1929:

I noticed your comment about drains for the soil spaces in the patio for planting vines and flowers. I think you said these drains were iron covered with asphalt. I think, in addition, they should be grouted in along their line of travel, as they will be under the patio and very inconvenient to ever take up if they should ever rust out. I would like to put them in in such manner so that they are at least good for my lifetime. I do not know but what by rights I ought to put copper or brass pipe in in a place like that. [Page 1, paragraph 3.]

Johnson to Thompson, March 16, 1929:

What do you think about putting copper pipe from now on under all floors and tile and patio where it is inaccessible and cannot be gotten at? Of course, if it is in the tunnel it

makes no difference, but where it is buried should we not use copper pipe? If we do not use copper pipe it should be tarred and buried in concrete. [Page 1, paragraph 5.]

Thompson to Johnson, March 17, 1929:

We are ready now to pour the pavement in the west half of the patio, which will probably be done this week. The part over the tunnels is well reinforced; that is, the steel is in place ready for concrete. [Page 1, paragraph 5.]

Johnson to Thompson, March 20, 1929:

SUNDIAL. I would fix the sun dial to show sun time. [Page 1, Item 6.]

Thompson to Johnson, March 21, 1929:

We have poured the pavement in the west half of the patio, and are getting ready to pour the east half. Then the tile can be laid. The tile men are finishing the lanas and walk around the music room. The music room floor is all completed.

I feel sure that the 3" iron pipe drain for the flower beds, well tarred and embedded in concrete will last indefinitely. [Page 1, paragraphs 3 and 4.]

Thompson to Johnson, March 25, 1929:

Tile men are putting the finishing touches on the lanas floor and around the music room. The west half of the patio is ready for tile and I suppose they will get at that soon. [Page 1, paragraph 5.]

Flower bed excavations are finished in the east half of the patio and some concrete will be placed in same today. [Page 1, paragraph 9.]

Thompson to Johnson, March 31, 1929:

Tile is now being laid in the west half of the patio. [Page 2, paragraph 2.]

Thompson to Johnson, April 8, 1929:

The tile men are now finishing the west half of the Patio; and some are setting tile in the grill frames in front of the radiators in the music room. [Page 1, paragraph 2.]

Thompson to Johnson, April 10, 1929:

The east half of the patio is about ready for concrete base and it will not be long before tile men will be laying tile there. Tile is finished in the west half of the patio and tilemen are laying tile on basement stairs now. [Page 1, paragraph 5.]

Thompson to Johnson, April 17, 1929:

We are getting ready today to pour concrete floor in the annex garage, and will soon put the concrete base in the east half of the patio. these two places will give the tile men a lot of space to work. They are laying tile on the east porch of the annex, ground floor;

also on the aprons in front of the main entrance and west porch at the foot of the outside stairs. [Page 1, paragraph 2.]

Thompson to Johnson, April 24, 1929:

The work in the main house is entirely finished. All radiators installed and painted. All Electric fixtures are installed and all other work finished including tile work, screen doors, etc., [then some exceptions listed]. [Page 1, paragraph 7 (item 2).]

Thompson to Johnson, April 28, 1929:

All roof tile work is finished and we have laid off the two roof men. [Page 1, paragraph 2.]

Tile floor is laid in the annex garage but not pointed up. [Page 1, paragraph 4.]

Thompson to Johnson, May 1, 1929:

Tile is all laid in the annex garage and tilers are pointing it up. Concrete base is laid in the east half of the patio which is now ready for tile. West half is all finished and soil in flower [boxes or beds]. [Page 1, paragraph 5.]

Thompson to Johnson, May 11, 1929:

Tile floor is now being laid in the power room in the annex. Nearly all tile is laid in the patio. [Page 1, paragraph 5.]

Thompson to Johnson, May 19, 1929:

The wall between the music room and service station is not yet plastered, nor is the wall in front of the guest house. Tile caps are now being set on these walls and after caps are finished the walls can then be plastered. [Page 1, paragraph 2.]

Thompson to Johnson, May 24, 1929:

The tile setters are now pointing up the tile floor in the power room. It will look very fine. Other tile setters are just finishing the cap tile on the walls in front of the guest house and between the music room tower and service station. [Page 1, paragraph 2.]

There were 9 [railroad] cars of cement, 1 of tile, 1 of plaster and the equivalent of 1 car of miscellaneous L.C.L. freight hauled during the past month. [Page 1, paragraph 6.]

Thompson to Johnson, May 31, 1929:

Walls are all capped with tile and two coats of plaster, in front of guest house. The wall between music room tower and service station is capped with tile and ready for plaster. Plasterers are today plastering the inside of the battery room. The floor of power room is tiled, and tile setters are just finishing the last corner of the patio in front of the guest room. [Page 1, paragraph 1.]

Thompson to Johnson, January 11, 1930:

All work here has stopped except setting tiles on the music room fireplace and plastering...in the guest house basement. [Page 1, paragraph 1.]

Thompson to Johnson, February 2, 1930:

The main house and annex are finished except a few minor things such as...music room fireplace, which is nearly finished. [Page 2, paragraph 2.]

Thompson to Johnson, June 27, 1930:

[Report on charges for cement, received from Monolith Company and the Riverside Company. Page 1, paragraph 5.]

Johnson to Thompson, August 26, 1930:

I ordered the tile cutter from the Kraftile Company, together with two dozen 7" cutting wheels. Same will be shipped on Sept. 2. [Page 1, paragraph 3.]

APPENDIX M, NOTES FROM A MAY 1971 INTERVIEW WITH JOE FORCELLIA

Notes from an Interview with Joe Forcellia by [Anonymous], May 1971. (The interviewer may have been Patrick Calhoun).

Joe Forcellia was a tile setter who worked at Scotty's Castle from about September 26, 1926 to May 15, 1927. He was hired by MacNeilledge in Los Angeles, and left that city on September 20, arriving at Scotty's Castle within a day or two, and was working at least by the 26th of September. He worked with another tile setter, George Hockett, and two helpers, one of which was Vern Andis.

Joe Forcellia indicated that most of the work he did was flooring and some walls mostly in the Main House, the bridge and decks. He indicated having done the Kitchen, Solarium (specifically the fountain base, but how much else here was not clear), Living Hall and stair, some of the second floor (specific locations not described), the bridge and "promenade" decks, bathrooms in the Main House and some of the Patio. He described doing the Solarium fountain base from broken 4 1/4 tile laid as a mosaic.

The work was laid out directly by MacNeilledge, usually for about two weeks at a time. If MacNeilledge did not like the results, they had to take it up and redo it.

Tile work was laid out as a room progressed. Full tile layout was a must; that is, no cut tile was permitted, the full tile pattern had to be laid out so that any leftover dimension was taken up in the joints. About half a room at a time was floated, laid out and set. Large tiles were about 7/8 inch thick. The tile was not walked on during installation, nor for 2 to 3 days after setting, then boards were laid on the tile so the grouting could be done and still not walk on the tile. The joints were filled about half full with grout and let set for a short time, then completely filled with grout and tooled. Grout was poured into the joints with a funnel.

The grout was tooled to a convex surface and was to be recessed 1/16 inch below the face of the tile. They ground hacksaw blades to achieve this and had them made up for 1/2", approximately 5/8", and 3/4" joints.

"Quarry" tile (probably means flooring tile) was waxed before being laid. It was waxed on-site with a liquid wax on the face only. He noted it was not easy to keep off the edges, which was necessary so as not to reduce the grout bond to the tile edge. But the waxed face meant that cleaning was quick and easy after the grout was dry.

After grouting, floors were allowed to set for 48 hours before any foot traffic was allowed. During this curing period the floors were apparently not kept dampened as it was cool enough inside the building that the grout did not dry too rapidly.

The float bed (into which the tile was set) was 1 1/4" to 1 1/2" thick. The mortar mix was 1 part cement to 4 parts sand.

Grouting mortar mix was generally 1 part cement to 3 parts sand, evidently with some variation to 1 part cement to 2 1/2 parts sand. Sand was deduced to have been from the site (the same as for the stucco) but was screened again by the tile setters to 60 mesh or finer. Mr. Forcellia used the term "natural" when talking about the cement. However, it is more probable that this meant "regular" or standard. Other historic records show one of the major orders of cement was from a company in Utah.

Mr. Forcellia described setting the bathroom wall tiling. After the plasterers applied the plaster scratch coat, the tilers set tile in a 1/8" bedding mortar. Tiles were 1/2" thick. No cut tiles were permitted; the tile laid out in full pattern, mortar joints adjusted so the work would come out to the dimension established. Joints were generally 3/8" to 1/2". After the tile work was complete, the stucco work was finished to the tile so that the face planes of both materials were approximately the same.

APPENDIX N, NOTES FROM A DECEMBER 29, 1982, INTERVIEW WITH PATRICK CALHOUN

Notes from an Interview of Patrick Calhoun by George Voyta, December 29, 1982.

Mr. Calhoun worked as a volunteer for about four years to clean and survey the tile that was stored in the tunnels in front of the Main House that had never been installed. He began his efforts in September 1970. The order of the following topics is the same as that found in the transcript of the interview. References, explanatory notes, comment or editorial notes in the following text are in brackets [].

Tile should be stored on edge, pairs face to face alternating with pairs back to back. Tile should not be stacked more than three rows high, each row separated with boards.

Discussing crazing, Mr. Calhoun suggested the possibility that a cause might have been the lack of talc [in the clay body]. [One of the primary causes of crazing is a poor fit of the clay body and the glaze. As the ceramic piece cools after firing, if the differential contraction of the clay and glaze is incompatible, putting too much stress in the glaze, it will result in crazing. Crazing is controlled by using several clays and/or with additives in the clay body.]

Mr. Calhoun described a tile intended for the pool that he felt was supplied by Gladding McBean, ca. 1931 or 1932. It is a 9 x 9 aqua tile scored on the back for half cuts and quarter cuts so it can be broken into smaller sizes.

When tile is warped or of inconsistent thickness, the tiler will sometimes break off parts of the back of the tile to aid in achieving evenness of the face plane when set. This is called "backing off". He also described "stoning" when making mitred joints.

Mr. Calhoun discussed the history of Gladding McBean [although the sequence of change is not entirely clear]. Apparently McBean was originally based in the Sausilto area near San Francisco and owned a source of clay known as Lincoln fire clay. They also made brick. Gladding was near Los Angeles, on Las Filds [sp?] Blvd., Glendale. Gladding bought Hermosa in Hermosa Beach, Calif. Hermosa added talc to their clay. Gladding closed a plant [which?] and moved main plant to Fos Fields [sp?] Blvd. in Glendale. Merged to form Gladding McBean. They called their tile Hermosa tile, then later Franciscan tile. He mentioned a company having been bought after WWII by Mosaic [presumably a tile company; which company was purchased was not clear]. Gladding McBean was bought by American Concrete and Pipe Co. [post-WWII ?]. Gladding Mcbean stamped their brick with their initials GMC within a circle. There are examples in the brick stored at Scotty's Castle.

In early tiling work, clay was used in the mortar, then later lime was used. [He did not indicate whether he thought lime was used in the mortar at Scotty's Castle. Joe Forcellia did not mention using lime in the mortar during his interview].

The patio tile was described as a red clay body but differing from the clay body used in what is commonly called quarry tile. The later differs by having a denser clay.

Tile was produced in the Los Angeles area from the early 1920s to the 1950s, mainly around Glendale; streets noted were Los Vidos [sp?] Blvd, San Fernando and Bugle Road, Hiland, Melrose and Pico. Other brick companies mentioned were Los Angeles Brick and Higgins Brick.

Calhoun thought most exterior tile came from California and some of the glazed [interior] tile from Spain. He made an indirect reference to the Malibu tile show and suspected that some tile was Malibu. [The invoices in the Scotty's Castle collection indicate that almost all the tile was produced by California companies, the known exception being the Don Quixote tiles in the Great Hall table. There are no invoices which would indicate any tile having been provided by Malibu Tile Co.] Mr. Calhoun discussed an unsuccessful effort to determine whether some tile was by a "Padrozen" [sp?] company of Spain. He also noted having found a tile plan for the pool.

Tile installation at Scotty's Castle was all done in full tile, without fillers (cut tile). Installation started with a levelling bed, referred to as a "sub-bed" or "roughed-in" bed, then a setting bed, approximately 2 inches thick, into which the tiles were set. The tile was then grouted and tooled, using a ground hacksaw blade. A minimum of seven days was required for the total curing time during the work. [See interview with Joe Forcellia].

Some terminology discussed were: "inserts" -- small glazed (decorative) tiles which complete a pattern; "band" -- a decorative course; "liner" -- a course in the field below a cap or decorative pattern.

The historic use of wax caused the tile to become darkened by wax penetration and waxing-in of dirt. Mr. Calhoun had apparently done some cleaning experimentation. The cleaner he used was Hilliards "Super Shine-All", used with Dutch Cleanser and/or fine silica sand and the use of a rotary buffing machine with stripping pads. The cleaner can also be used by itself, wiping it up after allowing it to dissolve dirt in or on the tilework.

Sulfanic acid is apparently a traditional cleaner but its use is not recommended without knowledge of its use and testing.

Mr. Calhoun described being in the building during some of the nuclear test events. He felt that the tests did cause cracks in the buildings. He feels that the fountain in the Great Hall can be repaired by re-piping and re-grouting the stonework. He feels that there has been some damage to tilework (mortar joints) by visitors; he also recommended shutting off the water to the bathrooms.

Cleaning the fountain in the entry court was discussed, possibly using the same cleaner discussed for floors. He did not recommend the use of copper sulfate to control algae because it discolors tile. Ammonia or chlorine would be preferable. Sulfanic acid can be used, 1 part to 5 parts water, given cautions previously noted. Muriatic acid is definitely not recommended because it etches the material. Mr. Calhoun felt that leakage in the fountain was occurring in the center wall.

One cause of "spalling" is from freezing after moisture has penetrated the tile. [The use of this term is descriptive of the failure, but it is an incorrect application in ceramics]. Tile can be patched (called "sticking") but it is difficult and better not to try it. It is preferable to replace a tile.

When replacing roofing tile, color differences will be evident because of different sources of clay and from batch to batch. Tiles have to be worked in to blend in the differences in color.

APPENDIX O, WOOD PRESERVATION COMPLIANCE DOCUMENTATION

XXX

ASSESSMENT OF ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

(Attach continuation sheets as necessary)

This form is required for all actions that have the potential to affect historic properties.

Originating Office

WR: 634

1. Park: Death Valley National Monument,
Scottys Castle Historic District
2. Description of proposed action:
[] implementing action included in plan under PMOA
[XX] Other PMOA Action Preservation Maintenance
[] Action not under PMOA.
3. Explain why the action is needed: See continuation sheet.
4. Cultural resources affected by proposed action (name and LCS number, if applicable)
See continuation sheet.
5. The proposed action will (Check as many as apply):
☐ Destroy historic fabric.
☒ Remove historic fabric.
☒ Replace historic fabric in kind.
☐ Replace missing historic fabric.
☐ Add non historic elements to a historic structure.
☐ Remove non historic elements from a historic structure.
☐ Alter historic terrain, ground cover, or vegetation.
☐ Introduce non historic elements (visible, audible, or atmospheric) into a historic setting or environment.
☐ Reintroduce historic elements in a historic setting or environment.
☐ Remove historic elements from a historic environment.
☐ Remove non historic elements from a historic environment.
☐ Disturb, destroy, impair, or render inaccessible archeological (surface or subsurface) resources.
☐ Possibly disturb presently unidentified archeological resources or historic fabric.
☐ Incur gradual deterioration of historic fabric, terrain, or setting.
☐ Other (Describe briefly):

Describe the indicated effect(s) concisely: See continuation sheet

- C. Identify supporting approved plan(s), comment and/or action thereon by Advisory Council on Historic Preservation, dates of ACHP action and NPS approval, and section(s) of the plan(s) pertaining to the action. If none, so state:

None

10. Prepared by: George H. Wright Title: RESTORATION SPECIALIST
11. Signature of Park Superintendent: [Signature] Date: 6/18/88

1. The foregoing assessment is adequate; the proposed action is consistent with all applicable NPS management policies, standards, and guidelines reviewed and concurred in by the Advisory Council; and the proposal incorporates all feasible measures to minimize adverse effects to cultural resources.
2. The proposed action is authorized by a planning document or program reviewed and concurred in by the Advisory Council.

Dee E Kelly 6-27-88
Regional Archeologist Date

Jordan S. Rameil 7/7/88
Regional Historian Date

Regional Historical Architect _____ Date 6/24/08

Regional Curator James T. Richardson Date 6/24/88

2/2/81

Date _____

Continuation Sheet

XX Form

Scottys Castle: Exterior Redwood

Provide protection for original, exterior redwood against weathering elements such as UV light, rain and temperature extremes. Some of these non-structural features are deteriorated, requiring repair or replacement.

<u>Structure</u>	<u>Deva #</u>	<u>Lcs #</u>
Chimesstower	SC-03	07613
Cookhouse	SC-06	07616
Entrance Gates	SC-23	07621
Gas House	SC-05	07615
Hacienda	SC-01	07612
Motel Unit - Garage	SC-07	07617
Power House & Pavilion	SC-04	07614
Scottys Castle & Annex	SC-02	00250
Stable	SC-11	07620

5. The exterior redwood on the listed buildings has been deteriorated by 65+ years of exposure to severe desert environment. Among the destructive characteristics are prolonged high temperatures, excessive ultra-violet light, particle burdened blasting winds, occasional saturating rains and freezing temperatures. Add to this a surface build-up of linseed oil which is cracked/checked and the results are predictable. The original burned color is faded, the linseed oil is unsightly, the surface wood fibers have been damaged or eroded away and the grain suffers from shrinkage cracks and checks. Damage also exists from normal wear and tear, abuse and insensitive alterations, as well as improper repairs.

It is proposed that a long range project be undertaken to remove the existing linseed oil build-up, make necessary repairs or in some instances remove deteriorated/damaged historic fabric and replace in kind. Then apply a pigmented wood preservative/coating to match, as closely as possible, what is determined to be the original color.

The Procedures to be followed are designed to minimize loss or impairment of historic fabric and its integrity.

Removal of existing linseed oil will be accomplished by using El Pico, marine grade paint & varnish remover, #6324. It is non-flammable, water soluble and has extra body. Objects and surfaces near the wood being worked will be protected by removal, masking or covering, as appropriate. Paint brush application of the stripper will enable control of its placement. Appropriate "working time" will be allowed for the stripper to soften the linseed oil, followed by removal with synthetic bristled brushes. This will minimize damage to the weather-raised grain of the soft redwood. This procedure to be repeated until complete removal is accomplished. Thorough water rinsing will flush away remaining residue.

Appropriate repairs will be made to damaged redwood, as required. Replacement with duplicated components will be introduced only after all "reasonable" options to save original fabric have been considered. Duplicate pieces will be inconspicuously identified with "NPS" - (current month and year).

When the wood is clean and dry, pigmented alkyd based preservative /coating to match original color will be applied. Approximate application sequence is as follows:

- A. Apply first coat of preservative with pigment.
- B. Approximately 2 months later, apply second coat of preservative with pigment.
- C. Approximately 1 year later, apply third coat of preservative without pigment.
- D. Additional applications should not be required for 5 or 6 years

The preservative brand selected is "REZ" by Pittsburgh Paints, an interior/exterior alkyd oil stain, S/T mixing base #77-860. It is semi-transparent and water repellant.

The coloring additives to closely match the original colors are "pigment in oil tinting color" obtained from GSA. Actual colors and quantities to be determined.

MYRNA Saxe
CONSERVATORS ART
AND ARCHITECTURE

9 June 1987

Don Creech
Maintenance Mechanic
Scotty's Castle
Death Valley National Monument
Death Valley, CA 92328

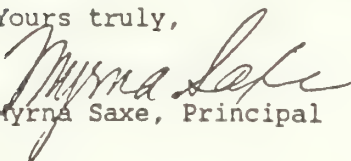
SUBJECT: SCOTTY'S CASTLE - PRELIMINARY INSPECTION

Dear Mr. Creech;

Here, attached, is a report on our preliminary inspection of wood and other construction materials at Scotty's Castle. Should you wish to pursue in-depth investigations in the areas discussed, I have spoken about the specific problems with both of the specialized engineers referred to in the report.

Please feel free to call if you have any questions during your various trials of stripping and coating as well as adhesives for re-adhering stucco.

Yours truly,


Myrna Saxe, Principal

1114 JEFFERSON AVENUE
SHEWAN PARK, CALIFORNIA 91401
TEL: (818) 241-2731 (10)

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June 9, 1987

SCOTTY'S CASTLE
DEATH VALLEY NATIONAL MONUMENT
DEATH VALLEY, CALIFORNIA

PRELIMINARY INSPECTION REPORT

INTRODUCTION

At the request of the National Park Service, Myrna Saxe, Conservators of Art and Architecture has performed a preliminary inspection of Scotty's Castle at Death Valley National Monument. This report provides a description of the use of wood on the structures, its condition and an approach to planning a treatment program. Also included are comments on observations of damage to other architectural materials.

LOCATION

Scotty's Castle complex, located in the north end of Death Valley National Monument at an elevation of 3000 feet, consists of the main two-story castle structure and nine other substructures, constructed from 1924 through 1931. All the structures are listed on the National Register of Historic Places.

CONSTRUCTION MATERIALS

Construction types vary from wood frame, concrete block and poured concrete. Parts of the main building are of concrete on the ground floor and wood frame on the second floor.

Except for three structures constructed with exterior redwood siding, the castle buildings have stucco exteriors with redwood appointments. The interiors are also appointed and furnished with wood. The redwood appointments are in the form of shutters, doors, windows, fascias, friezes, porches, balustrades, wall and ceiling panelling and beams. Hidden wood framing was not inspected..

CLIMATE

Average temperatures and relative humidity range from 106 degrees F. and 8% respectively in the summer to 30 degrees F. and 40% in winter. The daily minimum to maximum temperature variation is commonly forty degrees F. The precipitation ranges from 2 to 4 inches per year. The atmosphere is clear and sunny 90% of the time, resulting in a high ultraviolet exposure. Primary weather direction is from the south. Nearly constant winds of 10 to 30 mph carry dust and sand particles. Interior and exterior temperature and humidity are monitored continuously. Humidifiers were placed at interior locations in 1984. Interior humidity is maintained at 30% to 35% RH.

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June 9, 1987
Scotty's CastleSEISMIC

The complex is located in an earthquake zone. Underground nuclear detonations occur nearby. The site is near the path of a Naval Air Test Station with frequent sonic booms. Seismic events are monitored by the Atomic Energy Commission.

WOOD

TREATMENT HISTORY

Except for the shiplap siding and furniture, all wood was originally tooled, then selectively scorched to accent tooling. Based on oral histories and existing documents the wood underwent the following treatments.

Exterior:

1930Boiled linseed oil stain
1947 through 1970....Linseed oil
1978.....Clear Watco Penta
1980.....Boiled linseed oil
1984.....Raw linseed oil
1986.....On shiplap siding, trial removal of
previous coatings and application of
pigmented preservative/coating.

Interior:

1930.....Waxed
Unknown.....Linseed oil on half of Italian Suite

WOOD CONDITION

In sheltered exterior areas the various coatings have darkened and crosslinked, in some cases causing expansion and splintering. Other damage on exteriors includes drying, warping, splitting and degeneration of end grains, particularly in areas of southern exposure.

Interior wood exhibits some cracks in ceiling beams and beam movement. These cracks appeared in 1983 and have since enlarged. A small crack appeared in the dining room table in 1978 and has since enlarged. Surfaces are in generally good condition.

TREATMENT RECOMMENDATIONS

Inasmuch as the wood is generally non-structural, every attempt should be made to preserve the existing wood, with minimal intervention, with its original surface texture and form.

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June 9, 1987
Scotty's Castle

RECOMMENDATIONS FOR REMOVAL OF COATINGS

Materials:

1. A solvent based, neutral pH, water soluble paint and epoxy remover containing Methylene Chloride, methanol and a thickening agent. Do not use acidic or alkaline chemicals.
2. Water, low in dissolved salts, if possible

Equipment:

1. Wooden spatulas of various sizes. Plastic spatulas may be used if they are not damaged by the paint stripper.
2. Garden hose.

Execution:

Apply 1/2 inch thick coat of paint stripper, following manufacturers instructions. Allow ten to twenty five minutes, depending upon temperature and humidity. When old linseed oils on surface has softened, remove all with wooden spatulas. Do not rinse. Apply a second application of paint stripper in the same manner to remove oil deposits embedded in wood. Scrape off and rinse with water at 50 p.s.i. maximum. Repeat a third time if necessary.

RECOMMENDATIONS FOR APPLICATION OF PIGMENTED COATING:

When wood is clean and dry apply pigmented alkyd based preservative/coating to match original color.

RECOMMENDATIONS FOR PATCHING AREAS OF END GRAIN DAMAGE:

After wood is stripped of previous coatings and impregnated with pigmented alkyd wood preservative/coating, fill missing and fragile areas with wood patch material (to be specified), pigmented to match newly treated surfaces.

OTHER OBSERVED DAMAGE

Stucco delaminating and buckling. Further test and methods development should include injection of adhesives while stucco is flattened with pressure.

Large horizontal cracks in stucco of main building between concrete first floor and wood frame second floor. Some vertical cracks at settling points. Possibly related to seismic events of various origins. Suggest structural engineering investigation of origin of structural movement.

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June 9, 1987
Scotty's CastleTEST AND ANALYSIS

Some types of damage may originate from structural movement. It is recommended that an assessment of possible structural defects be investigated by a structural engineer with experience in historic structures in dry climates. See referral for Structural Engineer.

Because of the historic and artistic nature of the decorative wood, large samples should not be extracted for analysis. Small samples should be extracted before and after treatment to assist in determining degree of damage, degree of penetration, effectiveness of treatment and predicted service life. See referral for wood test laboratories.

REFERRAL FOR STRUCTURAL INVESTIGATION

By means of Purchase Order from National Parks Service:

Todd Rutenbeck
Bureau of Reclamation
Engineering and Research Center
D-1512
P.O. Box 25007
Denver Federal Center
Denver, Colorado 80025

Telephone (303) 2366113
FTS: 776-6113

REFERRAL FOR WOOD ANALYSIS

By means of Purchase Order from National Parks Service:

Bill Dost, Director
or,
Barry Gammon, Assistant to Director
University of California
Wood Building Research Center
1301 South 46th Street
Richmond, CA 94804

Telephone: (415) 231-9404

PHOTOGRAPHS ATTACHED

XXX FORM

ASSESSMENT OF ACTIONS HAVING AN EFFECT ON CULTURAL RESOURCES

(Attach continuation sheets as necessary)

This form is required for all actions that have the potential to affect historic properties.

Originating Office

WR: 634

1. Park: Death Valley National Monument
Scottys Castle Historic District

2. Description of proposed action:

[] Implementing action included in plan under PMOA
 [XX] Other PMOA Action PRESERVATION MAINTENANCE
 [] Action not under PMOA.

3. Explain why the action is needed: To comply with State and Federal Sanitation Regulations. See continuation sheet.

4. Cultural resources affected by proposed action (name and LCS number, if applicable):

Annex DEVA # SC-02 LCS # 00250

5. The proposed action will (Check as many as apply):

XX Destroy historic fabric.
XX Remove historic fabric.
XX Replace historic fabric in kind.
XX Replace missing historic fabric.
 ___ Add non historic elements to a historic structure.
 ___ Remove non historic elements from a historic structure.
 ___ Alter historic terrain, ground cover, or vegetation.
 ___ Introduce non historic elements (visible, audible, or atmospheric) into historic setting or environment.
 ___ Reintroduce historic elements in a historic setting or environment.
 ___ Remove historic elements from a historic environment.
 ___ Remove non historic elements from a historic environment.
 ___ Disturb, destroy, impair, or render inaccessible archeological (surface or subsurface) resources.
 ___ Possibly disturb presently unidentified archeological resources or historic fabric.
 ___ Incur gradual deterioration of historic fabric, terrain, or setting.
 ___ Other (Describe briefly):

Describe the indicated effect(s) concisely: See continuation sheet.

6. Identify supporting approved plan(s), comment and/or action thereon by Advisory Council on Historic Preservation, dates of ACHP action and NPS approval, and section(s) of the plan(s) pertaining to the action. If none, so state:

None

7. Identify relevant NPS management policies and guidelines:

DEVA General Management Plan (proposed draft FY88).
NPS-28, Cultural Resource Management Guidelines.

Describe any measures planned to minimize or lessen the loss or impairment of historic fabric, setting, integrity, or data: See continuation sheet.

9. Identify supporting study data and date(s) of preparation (attach if feasible):

Historic Structures Condition Study, 10-82 & 11-85.

6. Prepared by: George D. Voyt Title: Restoration Specialist

1. Signature of Park Superintendent: [Signature]

Date: 6/18/88

Regional Cultural Resources Staff Review and Certification

1. The foregoing assessment is adequate; the proposed action is consistent with all applicable NPS management policies, standards, and guidelines reviewed and concurred in by the Advisory Council; and the proposal incorporates all feasible measures to minimize adverse effects to cultural resources.

2. The proposed action is authorized by a planning document or program reviewed and concurred in by the Advisory Council.

(Negative certifications must be justified on attachments.)

	Yes	No	N/A
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Rogert Kelly 6-27-88
Regional Archeologist Date

[] Energy Consultation Held

	Yes	No	N/A
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Jordan S. Camell 2/7/88
Regional Historian Date

Regional Energy Coordinator

	Yes	No	N/A
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

[Signature] 6/24/88
Regional Historical Architect Date

	Yes	No	N/A
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Maria Duchala 6/24/88
Regional Curator Date

Additional requirements of the proposed action:

Regional Director Approval of Proposed Action including Additional Requirements

The proposed action, including any additional requirements stated above, meets all conditions in B.1 and 2.

7/7/88

[Signature]

WASO Record

Assessment received and noted:

Associate Director,
Cultural Resources Management

Date

Continuation Sheet

XXX Form

Scottys Castle: Annex Screened Porch

2. A "Blanket" XXX form (exterior redwood) addressing built-up linseed oil removal, minor redwood repairs, staining and preservative application is pending. But, due to the extent of wood deterioration in the Annex Screened Porch, this additional authorization is being submitted.

It is proposed to duplicate and replace approximately 50% of the ceiling screen frames, nearly all screen moldings and replace screening material as required. The porch screen doors may require total disassembly & regluing. One of the front support posts needs to be raised approximately 1 1/4 inches and secured appropriately in its proper position.

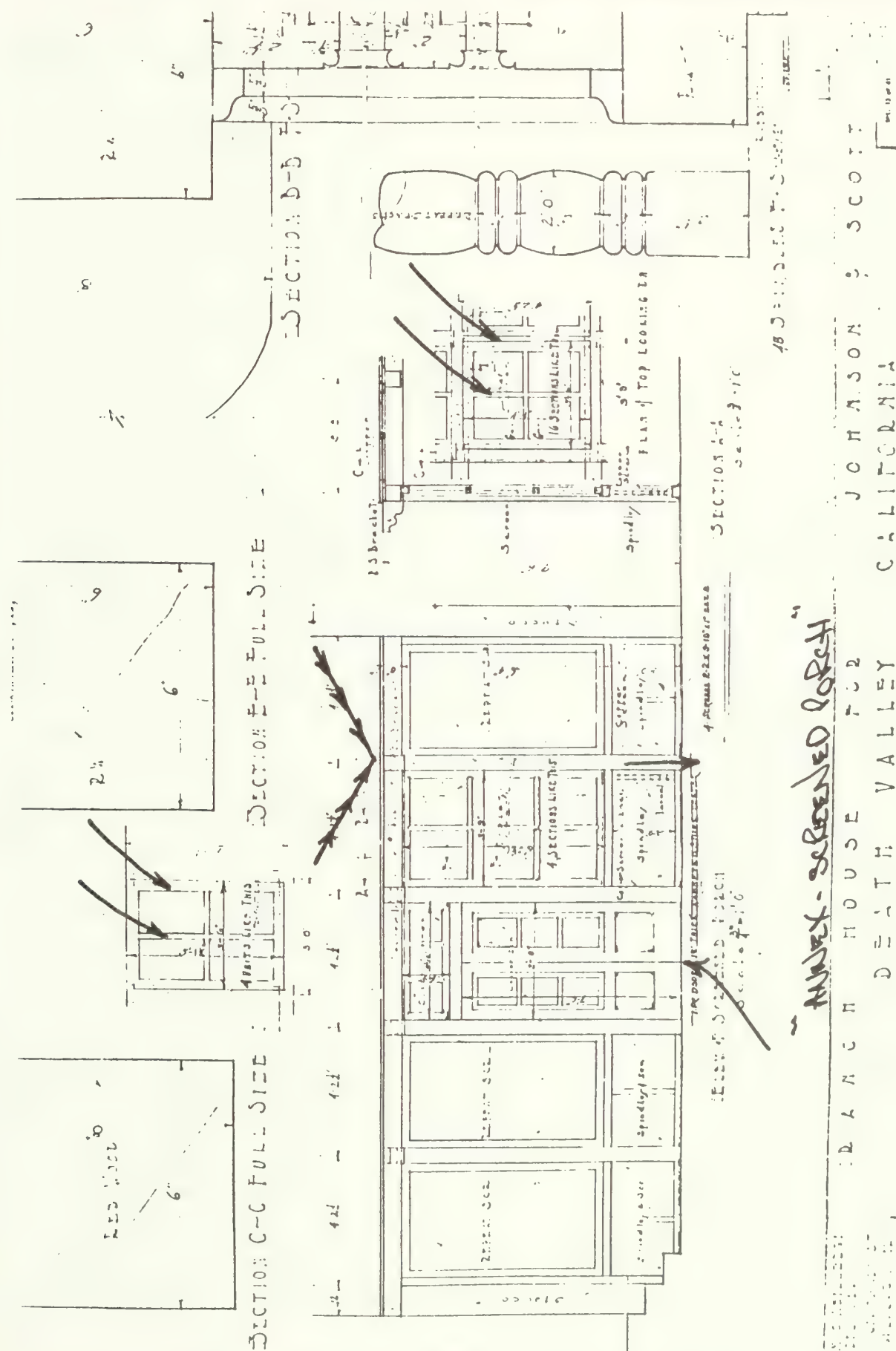
3. These repairs are necessary because screen frame and trim deterioration has caused pieces of redwood to split off and fall to the porch floor or blow off the screened ceiling. This has resulted in the loss of some screening material, permitting flying insects to enter the music room when ventilating the Annex. The porch screen doors appear to have failed glue joints, causing damaging drag at the tile floor. For reasons unknown at this time one of the front support posts has dropped and racked adjacent framing & screen units out of square. In addition, this porch is becoming increasingly unsightly. (See attached drawings).

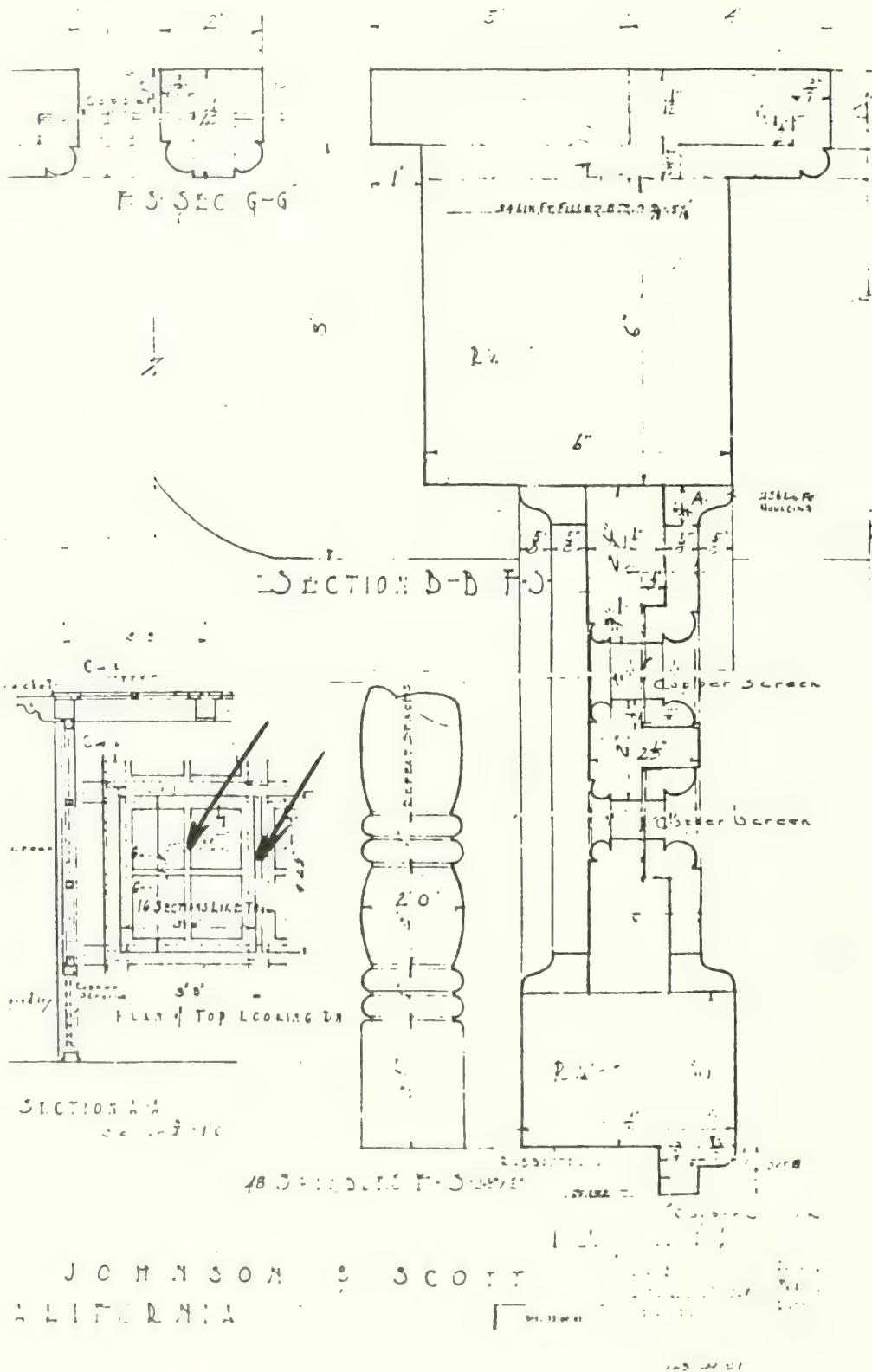
5. The Destruction of some historic fabric during its removal is unavoidable due to its extremely fragile, deteriorated condition. This will be especially true in the rebuilding of ceiling screen frames. The top side of this redwood has been exposed to more direct sunlight, than probably any other in the district. The heat and UV light has resulted in such dry, cracked wood that reassembly nailing/gluing is questionable, even if a successful disassembly is possible. To effect a practical, successful repair, a piece by piece evaluation will be made as work progresses.

Replacement of existing and missing historic fabric will be done accurately with appropriate materials. In this case, clear heart redwood (mostly vertical grain) will be used. Shaper/router cutters will be custom ground to duplicate original profiles and all new pieces inconspicuously stamped "NPS -(current month & year)".

8. Discretion and care will be exercised to keep loss or impairment of historic fabric, integrity and data to a minimum. When practical, only sections of a frame will be replaced, rather than an all new unit. Photographic documentation will take place on a regular basis, appropriate samples will be identified/ stored and a paper trail of restoration activities left for future reference.

Surrounding objects and surfaces will be reasonably protected from on-going work activities. Furniture will be moved out and stored. The porch floor fountain will be covered with a plywood box and the floor tile covered with old carpeting.





APPENDIX P, LIFE CYCLE COST CALCULATIONS FOR ALTERNATIVE CLIMATE CONTROL SYSTEMS

System 1 (Existing systems) -

Initial Cost -	0
Energy Cost -	
Electricity - $3,953 \times 9.52 =$	37,633
Fuel Oil - $883 \times 12.40 =$	10,949
Boiler Replacement (Year 10) - $3,925 \times 0.39 =$	1,531
Heating System Repair (Year 15) - $1,500 \times 0.24 =$	360
Humidifier Replacement (Year 5) - $1,760 \times 0.62 =$	1,091
Humidifier Replacement (Year 10) - $1,760 \times 0.39 =$	686
Humidifier Replacement (Year 15) - $1,760 \times 0.24 =$	422
Humidifier Replacement (Year 20) - $1,760 \times 0.15 =$	264
Humidifier Replacement (Year 25) - $1,760 \times 0.09 =$	158
Salvage Value for Humidifiers =	0
Evap. Cooler Replacement (Year 10) - $622 \times 0.39 =$	243
Salvage Value - $622 \times 0.1 \times 0.39 =$	-24
Evap. Cooler Replacement (Year 20) - $622 \times 0.15 =$	93
Salvage Value - $622 \times 0.1 \times 0.15 =$	-9
Window A/C Unit Replacement (Year 10) - $700 \times 0.39 =$	273
Salvage Value - $700 \times 0.1 \times 0.39 =$	-27
Window A/C Unit Replacement (Year 20) - $700 \times 0.15 =$	105
Salvage Value - $700 \times 0.1 \times 0.15 =$	-11
Maintenance Cost - $13,293 \times 11.65 =$	<u>120,700</u>
Total Life Cycle Cost -	\$174,437

System 2 (Existing systems with improvements to heating system) -

Initial Cost -	8,854
Energy Cost -	
Electricity - $3,094 \times 9.52 =$	29,455
Fuel Oil - $4,573 \times 12.40 =$	56,705
Boiler Replacement (Year 10) - $3,925 \times 0.39 =$	1,531
Heating System Repair (Year 10) - $1,500 \times 0.39 =$	585
Heating System Repair (Year 20) - $1,500 \times 0.15 =$	225
Humidifier Replacement (Year 5) - $1,760 \times 0.62 =$	1,091
Humidifier Replacement (Year 10) - $1,760 \times 0.39 =$	686
Humidifier Replacement (Year 15) - $1,760 \times 0.24 =$	422
Humidifier Replacement (Year 20) - $1,760 \times 0.15 =$	264
Humidifier Replacement (Year 25) - $1,760 \times 0.09 =$	158
Salvage Value for Humidifiers =	0
Evap. Cooler Replacement (Year 10) - $622 \times 0.39 =$	243
Salvage Value - $622 \times 0.1 \times 0.39 =$	-24
Evap. Cooler Replacement (Year 20) - $622 \times 0.15 =$	93
Salvage Value - $622 \times 0.1 \times 0.15 =$	-9
Window A/C Unit Replacement (Year 10) - $700 \times 0.39 =$	273

Salvage Value - $700 \times 0.1 \times 0.39 =$	-27
Window A/C Unit Replacement (Year 20) - $700 \times 0.15 =$	105
Salvage Value - $700 \times 0.1 \times 0.15 =$	-11
Maintenance Cost - $14,710 \times 11.65 =$	<u>133,567</u>
Total Life Cycle Cost -	\$234,186

System 3 (System 2 with improvements to the building envelope)

Initial Cost -	28,964
Energy Cost -	
Electricity - $2,888 \times 9.52 =$	27,494
Fuel Oil - $4,261 \times 12.40 =$	52,836
Boiler Replacement (Year 12) - $3,925 \times 0.32 =$	1,256
Heating System Repair (Year 10) - $1,500 \times 0.39 =$	585
Heating System Repair (Year 20) - $1,500 \times 0.15 =$	225
Humidifier Replacement (Year 7) - $1,760 \times 0.51 =$	898
Humidifier Replacement (Year 14) - $1,760 \times 0.26 =$	458
Humidifier Replacement (Year 21) - $1,760 \times 0.14 =$	246
Salvage Value for Humidifiers =	0
Evap. Cooler Replacement (Year 10) - $622 \times 0.39 =$	243
Salvage Value - $622 \times 0.1 \times 0.39 =$	-24
Evap. Cooler Replacement (Year 20) - $622 \times 0.15 =$	93
Salvage Value - $622 \times 0.1 \times 0.15 =$	-9
Window A/C Unit Replacement (Year 10) - $700 \times 0.39 =$	273
Salvage Value - $700 \times 0.1 \times 0.39 =$	-27
Window A/C Unit Replacement (Year 20) - $700 \times 0.15 =$	105
Salvage Value - $700 \times 0.1 \times 0.15 =$	-11
Maintenance Cost - $11,440 \times 11.65 =$	<u>103,875</u>
Total Life Cycle Cost -	\$217,480

System 4 (Package air conditioners with water-cooled condensers, electric resistance heat, and electrode boiler type humidifiers)

Initial Cost -	282,407
Energy Cost -	
Electricity - $36,398 \times 9.52 =$	346,509
A/C Unit Replacement (Year 20) - $66,697 \times 0.15 =$	10,005
Salvage Value - $66,697 \times 0.1 \times 0.15 =$	-1,000
Maintenance Cost - $5,444 \times 11.65 =$	<u>49,432</u>
Total Life Cycle Cost -	\$687,353

System 5 (Package water source heat pumps with electrode boiler type humidifiers)

Initial Cost -	280,064
Energy Cost -	

Electricity - $20,578 \times 9.52 =$	195,903
Heat Pump Replacement (Year 15) - $80,373 \times 0.24 =$	19,290
Salvage Value - $80,373 \times 0.1 \times 0.24 =$	-1,929
Maintenance Cost - $6,208 \times 11.65 =$	<u>56,369</u>
Total Life Cycle Cost -	\$549,697

System 6 (Central air-cooled chiller with fan-coil units, electric resistance heat, and central electric humidification system)

Initial Cost -	369,390
Energy Cost -	
Electricity - $37,756 \times 9.52 =$	359,437
Chiller Replacement (Year 20) - $26,000 \times 0.15 =$	3,900
Salvage Value - $26,000 \times 0.1 \times 0.15 =$	-390
Fan Coil Unit Replacement (Year 15) - $24,300 \times 0.24 =$	5,832
Salvage Value - $24,300 \times 0.1 \times 0.24 =$	-583
Humidifier Boiler Replacement (Year 20) -	
$3,230 \times 0.15 =$	485
Salvage Value - $3,230 \times 0.1 \times 0.15 =$	-48
Humidifier Replacement (Year 20) - $13,125 \times 0.15 =$	1,969
Salvage Value - $13,125 \times 0.1 \times 0.15 =$	-197
Chilled Water Pump Replacement (Year 15) -	
$2,100 \times 0.24 =$	504
Salvage Value - $2,100 \times 0.1 \times 0.24 =$	-50
Maintenance Cost - $4,181 \times 11.65 =$	<u>37,963</u>
Total Life Cycle Cost -	\$778,212

System 7 (Central air-cooled chiller with fan-coil units, propane gas-fired hydronic heat, and central propane gas-fired humidification system)

Initial Cost -	403,398
Energy Cost -	
Electricity - $15,951 \times 9.52 =$	151,854
LP-Gas - $7,159 \times 9.68 =$	69,299
Chiller Replacement (Year 20) - $26,000 \times 0.15 =$	3,900
Salvage Value - $26,000 \times 0.1 \times 0.15 =$	-390
Fan Coil Unit Replacement (Year 15) - $24,300 \times 0.24 =$	5,832
Salvage Value - $24,300 \times 0.1 \times 0.24 =$	-583
Humidifier Boiler Replacement (Year 20) -	
$1,545 \times 0.15 =$	232
Salvage Value - $1,545 \times 0.1 \times 0.15 =$	-23
Humidifier Replacement (Year 20) - $13,125 \times 0.15 =$	1,969
Salvage Value - $13,125 \times 0.1 \times 0.15 =$	-197
Chilled Water Pump Replacement (Year 15) -	
$2,100 \times 0.24 =$	504
Salvage Value - $2,100 \times 0.1 \times 0.24 =$	-50

Hot Water Pump Replacement (Year 15) - $1,408 \times 0.24 =$	338
Salvage Value - $1,408 \times 0.1 \times 0.24 =$	-34
Maintenance Cost - $5,460 \times 11.65 =$	<u>49,577</u>
Total Life Cycle Cost -	\$685,626

System 8 (Central air-cooled chiller with fan-coil units, oil-fired hydronic heat, and central oil-fired humidification system)

Initial Cost -	435,556
Energy Cost -	
Electricity - $16,019 \times 9.52 =$	152,501
Fuel Oil - $6,601 \times 12.40 =$	81,852
Chiller Replacement (Year 20) - $26,000 \times 0.15 =$	3,900
Salvage Value - $26,000 \times 0.1 \times 0.15 =$	-390
Fan Coil Unit Replacement (Year 15) - $24,300 \times 0.24 =$	5,832
Salvage Value - $24,300 \times 0.1 \times 0.24 =$	-583
Humidifier Boiler Replacement (Year 20) -	
$1,545 \times 0.15 =$	232
Salvage Value - $1,545 \times 0.1 \times 0.15 =$	-23
Humidifier Replacement (Year 20) - $13,125 \times 0.15 =$	1,969
Salvage Value - $13,125 \times 0.1 \times 0.15 =$	-197
Chilled Water Pump Replacement (Year 15) -	
$2,100 \times 0.24 =$	504
Salvage Value - $2,100 \times 0.1 \times 0.24 =$	-50
Hot Water Pump Replacement (Year 15) - $1,408 \times 0.24 =$	338
Salvage Value - $1,408 \times 0.1 \times 0.24 =$	-34
Fuel Oil Pump Replacement (Year 15) - $900 \times 0.24 =$	216
Salvage Value - $900 \times 0.1 \times 0.24 =$	-22
Maintenance Cost - $5,628 \times 11.65 =$	<u>51,102</u>
Total Life Cycle Cost -	\$732,703

System 9 (System 6 above with ice storage for peak load shaving)

Initial Cost -	490,081
Energy Cost -	
Electricity - $14,870 \times 9.52 =$	141,562
LP-Gas - $7,159 \times 9.68 =$	69,299
Chiller Replacement (Year 20) - $26,000 \times 0.15 =$	3,900
Salvage Value - $26,000 \times 0.1 \times 0.15 =$	-390
Fan Coil Unit Replacement (Year 15) - $24,300 \times 0.24 =$	5,832
Salvage Value - $24,300 \times 0.1 \times 0.24 =$	-583
Humidifier Boiler Replacement (Year 20) -	
$1,545 \times 0.15 =$	232
Salvage Value - $1,545 \times 0.1 \times 0.15 =$	-23

Humidifier Replacement (Year 20) - $13,125 \times 0.15 =$	1,969
Salvage Value - $13,125 \times 0.1 \times 0.15 =$	-197
Chilled Water Pump Replacement (Year 15) - $6,300 \times 0.24 =$	1,512
Salvage Value - $6,300 \times 0.1 \times 0.24 =$	-151
Hot Water Pump Replacement (Year 15) - $1,408 \times 0.24 =$	338
Salvage Value - $1,408 \times 0.1 \times 0.24 =$	-34
Maintenance Cost - $6,006 \times 11.65 =$	<u>54,534</u>
Total Life Cycle Cost -	\$767,881

System 10 (System 4 with improvements to the building envelope)

Initial Cost -	300,174
Energy Cost - Electricity - $18,607 \times 9.52 =$	177,139
Heat Pump Replacement (Year 15) - $80,373 \times 0.24 =$	19,290
Salvage Value - $80,373 \times 0.1 \times 0.24 =$	-1,929
Maintenance Cost - $5,593 \times 11.65 =$	<u>50,784</u>
Total Life Cycle Cost -	\$545,458

APPENDIX Q, ELECTRICAL GENERATOR SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

GENERATOR SET SIZING CALCULATIONS

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load		Notes:
1	2	3	4	5	6	7	8	9	10	11	12	13	Name Of Load: Voltage Dip, Etc.		
HP	Code		Volts	Tap	KVAs	PF	KW's		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
1	SET	1	(20HES)		1-5)						50KVA	40 KW			
2	10 G	3	460	-	65	.48	31	10.7	8.7						
3	10 G	3	460	-	65	.48	31	10.7	8.7						
4	10 G	3	460	-	65	.48	31	10.7	8.7						
5	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
6	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
7	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
8					341		174	57	46						
9	SET	2	(20HES)		6-10)										
10	10 G	3	460	-	65	.48	31	10.7	8.7						
11	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
12	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
13	7.5 G	3	460	-	48.5	.55	27	8.4	6.5						
14	5 G	3	460	-	32.4	.60	19.4	5.4	4.8						
15															
16					243		131	41	33						

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Motor Information			Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Motor		Accumulated Load		Notes:
From	Motor Nameplate		4	5	6	7	8	9	10	11	12	13	
HP	Code	Volts	Tap	Mult	KVAs	PF	KWs		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13	Name Of Load: Voltage Dip. Etc.
1	SET	3	(2046S)		11-17)								
2													
3	7.5 G	3	460		48.5	.55	27	10.7	8.7				
4	S G	3	460		32.4	.6	19.4	5.9	4.8				
5	S G	3	460		32.4	.6	19.4	5.9	4.8				
6	3 H	3	460		21.9	.6	13.1	3.7	2.8				
7	3 H	3	460		21.9	.6	13.1	3.7	2.8				
8	3 H	3	460		21.9	.6	13.1	3.7	2.8				
9													
10					179		105	30	27				
11													
12													
13													
14													
15													
16													

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Motor Information From			Reduced Voltage Motor Starting			Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load			Notes: Name Of Load: Voltage Dip, Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13				
HP	Code		Volts	Tap	Mult	KVA's	PF	KW's		Max KVA Add 6 to 12	Max KW Add 7 to 13		Cont KVA Add 8 to 12	Cont KW Add 9 to 13		
1	SET	4	(2000ES 1-8)													
2																
3	10					65	.48	31	10.7	8.7						
4	10					65	.48	31	10.7	8.7						
5	10					65	.48	31	10.7	8.7						
6	7.5					48.5	.55	27	8.4	6.5						
7	7.5															
8	7.5															
9	7.5															
10	7.5															
11	7.5															
12						486		255	83	65						
13																
14																
15																
16																

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load		Notes: Name Of Load: Voltage Dip, Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13			
HP	Code		Volts	Tap	Mult	KVAs	PF	KWs	Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
1	SCT 5 (2000 9-17)														
2															
3	10					65	.48	31	13.7	8.7					
4	7.5					48.5	.55	27	8.4	6.5					
5	5					32.4	.6	19.4	5.4	4.8					
6	5					32.4	.6	19.4	5.4	4.8					
7	5					32.4	.6	19.4	5.4	4.8					
8	3					21.9	.6	13.1	3.7	2.8					
9	3					21.9	.6	13.1	3.7	2.8					
10	3					21.9	.6	13.1	3.7	2.8					
11															
12						277		156	47	38					
13															
14															
15															
16															

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: All heat pumps and existing 50 KVA non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

1	2	3	4	5		6		7	8		9		10		11		12		13		Notes:
				Volts	Tap	Mult	KVAs	PF	KWs	Motor Running Load	Motor Starting Load	Motor Running Load	Max KVA Add 6 to 12	Max KW Add 7 to 13	Accumulated Load Of Incoming Motor	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
HP	Motor Nameplate	Coils																			Name Of Load: Voltage Dip, Etc.
1																					
2	SET 1						341		174	57	46		391	214			50	40			
3	SET 2						243		131	41	33		350	217			107	86			
4	SET 3						179		105	30	27		327	224			148	119			
5	5% TEMP DERATE												343	235			178	146			
6																	187	153			250.0 KW
7																					
8																					
9																					
10																					
11																					
12	SET 1						341		174	57	46		391	214			50	40			
13	SET 3						179		105	30	27		286	191			107	86			
14	SET 2						243		131	41	33		380	244			137	113			
15	5% TEMP DERATE												399	256			178	146			
16																	187	153			250.0 KW

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: All heat pumps and existing 50 KVA non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load			Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load			Notes: Name Of Load: Voltage Dip, Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13					
HP	Code		Volts	Tap	Mult	KVAs	PF	KWs	Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13					
1											50	40					
2	SET	2				243		131	293	171	91	73					
3	SET	3				179		105	270	178	121	100					
4	SET	1				341		174	462	274	178	146					
5		5%	TEMP DERATE						485	288	187	153					
6													300.0 KW				
7																	
8																	
9	SET	2				243		131	293	171	50	40					
10	SET	1				341		174	432	247	148	119					
11	SET	3				179		105	327	224	178	146					
12		5%	TEMP DERATE						343	235	187	153					
13													250.0 KW				
14																	
15																	
16																	

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: All heat pumps and existing 50 KVA non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load		Notes: Name Of Load: Voltage Dip, Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13			
HP	Code		Volts	Tap	KVA's	PF	KWs		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
1											50	40			
2	SET	3			179		105	30	27	145	80	67			
3	SET	1			341		174	57	46	241	137	113			
4	SET	2			243		131	41	33	244	178	146			
5										256	187	153			
6														250.0 KW	
7															
8															
9	SET	3			179		105	30	27	145	50	40			
10	SET	2			243		131	41	33	198	80	67			
11	SET	1			341		174	57	46	274	121	100			
12										288	187	153			
13														300.0 KW	
14															
15															
16															

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: All heat pumps and existing 50 KVA non-motor loads.

Note: Derating: Temp. 5%

Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate			Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Motor		Accumulated Load		Notes:
1	2	3	4	5	6	7	8	9	10	11	12	13	
HP	Code		Volts	Tap	KVAs	PF	KWs		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13	Name Of Load: Voltage Dip. Etc.
1											50	40	
2	SET	4			486		255	83	536	295	133	105	
3	SET	5			277		156	47	410	261	180	143	
4		5% TEMP			DERATE				431	274	189	153	
5													300 KW
6													
7													
8													
9	SET	5			277		156	47	327	196	50	40	
10	SET	5			486		255	83	583	333	97	78	
11		5% TEMP			DERATE				612	350	180	143	
12											189	153	
13													350 KW
14													
15													
16													

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: Heat pumps only.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load		Notes:
1	2	3	4	5	6	7	8	9	10	11	12	13			Name Of Load: Voltage Dip. Etc.
HP	Code		Volts	Tap	Mult	KVAs	PF	KWs	Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
1											-	-			
2	SET	1				341		174	341	174	57	46			
3	SET	2				243		131	300	177	98	79			
4	SET	3				179		105	277	184	128	106			
5		50%	DERATE						291	193	134	111			175.0 KW

175.0 KW

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: All heat pumps and existing and future 100 KVA non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Motor			Accumulated Load		Notes: Name Of Load: Voltage Dip, Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13			
HP	Code		Volts	Tap	KVAs	PF	KWs		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13			
1											100	80			
2	SET	1			341		174	57	46	254	157	126			
3	SET	2			243		131	41	33	257	198	159			
4	SET	3			179		105	30	27	264	228	186			
5		50%		DERATE					396	277	239	195			
6													300.0 KW		
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: Heat pumps - Zones 1 - 5 (Set 1) and 100 KVA existing and future non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Of Incoming Motor		Accumulated Load Plus Starting		Accumulated Load		Notes:
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
HP	Code	Volts	Tap	Mult	KVAs	PF	KWs	Max KW	Add 6 to 12	Add 7 to 13	Cont KVA	Cont KW	Add 8 to 12	Add 9 to 13		Name Of Load: Voltage Dip. Etc.
1																
2	SET 1				341		174	57	46	254	100	80	157	126		
3									463	267	165	132				
4																300.0 KW
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: Heat pumps - Zones 6 - 10 (Set 2) and 100 KVA existing and future non-motor loads.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information From Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load		Accumulated Load Plus Load Of Incoming Starting Motor			Accumulated Load			Notes: Name Of Load: Voltage Dip. Etc.
1	2	3	4	5	6	7	8	9	10	11	12	13				
HP	Cord		Volts	Tap	KVAs	PF	KWs		Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13				
1																
2	SET 2				243		131	41	33	343	211	80	100	141	113	
3			5%	DERATE					360	222	148	119				250.0 KW
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																

GENERATOR SET SIZING CALCULATIONS

Scotty's Castle
Death Valley National Monument
California

Load: Heat pumps - Zones 1 - 5 (Set 1) only and Zones 6 - 10 (Set 2) only.

Note: Derating: Temp. 5%
Ambient T = 120°F (derate 1% for every 10°F above 77°F)

Motor Information from Motor Nameplate				Reduced Voltage Motor Starting		Motor Starting Load		Motor Running Load			Accumulated Load Plus Load Of Incoming Starting Motor				Accumulated Load		Notes: Name Of Load: Voltage Dlp. Etc.
2	3	4	5	6	7	8	9	10	11	12	13						
1P	Code	Units	Tap	Mult	KVAs	PF	KW's	Max KVA Add 6 to 12	Max KW Add 7 to 13	Cont KVA Add 8 to 12	Cont KW Add 9 to 13						
SET 1																	

APPENDIX R, COST ESTIMATE CALCULATIONS

Estimate by Denver Service Center for 1991; for later years, add annual escalation.

Labor rate calculations were based on approximate hourly rate for 1991, rounded, plus benefits (30%), plus overhead (15%).

Crew leader, WG-9 or 10:	$(\$15/\text{hr}) (1.30) (1.15) = \$22/\text{hr} = \$179/\text{day}$
Maint. worker, WG-5 or 7:	$(\$13/\text{hr}) (1.30) (1.15) = \$19/\text{hr} = \$155/\text{day}$
Laborer, WG-3 or 5:	$(\$12/\text{hr}) (1.30) (1.15) = \$18/\text{hr} = \$144/\text{day}$

Daily labor rates for various sizes of preservation crew:

Crew of 2:	1 crew leader	\$179/day	
	1 maint. worker	<u>155/day</u>	
		\$334/day, use	\$350/day
Crew of 3:	1 crew leader	\$179/day	
	1 maint. worker	155/day	
	1 laborer	<u>144/day</u>	
		\$478/day, use	\$500/day
Crew of 4:	1 crew leader	\$179/day	
	2 maint. workers	310/day	
	1 laborer	<u>144/day</u>	
		\$ 633/day, use	\$650/day
Crew of 5:	1 crew leader	\$179/day	
	2 maint. workers	310/day	
	2 laborers	<u>288/day</u>	
		\$777/day, use	\$800/day

STORM DRAINAGE

1. Lower soil level in Patio planter boxes (see Tile section).
2. Regrade and resurface Entry Court for positive surface drainage, remove subsurface drains; new paving required for accessibility and dust control, provide color treatment for more gravel-like appearance.

Remove existing paving	27,000 sq. ft./9 (\$4/ sq. yd.)	\$ 12,000
Remove existing drains	220 ft. (\$5/ ft.)	1,100
Regrade, new base	27,000 sq. ft./9 (\$2/sq. yd.)	6,000
New paving	27,000 sq. ft./9 (\$12/sq. yd.)	<u>\$ 36,000</u>
		\$ 55,100

3. Adjust elevation of drain pipes in main tunnel roof slab (along swimming pool) to prevent ponding and connect with new piping in tunnel to existing storm drain piping.

Modify slab drains	7 [\$50 + 1 crew day (\$800/day)]	\$ 5,950
New drain piping	300 ft (\$20/ ft.)	\$ 6,000

4. Restore grades at foundation wall in front of Main House, adjust grades at porch slabs.

Fill and grading, compacted	3 crew days (\$650/day)	\$ 1,950
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5. Regrade area west of Castle and north of Annex for positive drainage.

Remove existing paving	6,000 sq. ft./9 (\$4/sq. yd.)	\$ 2,667
Grading	12000 sq. ft./9 (\$2/sq. yd.)	2,667
Resurfacing	12000 sq. ft./9 (\$10/sq. yd.)	<u>13,333</u>
		\$ 18,667

6. Clean and regrade swale on hillside north of Annex for positive drainage.

Cleaning and regrading	5 crew days (\$650/day)	\$ 3,250
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7. Treat concrete slab at rear of Annex (included in Structural section).

8. Monitor leakage in Main House basement walls (assume monitoring costs in regular maintenance program).

PEST MANAGEMENT

1. Continue and enhance treatment for termites, carpenter bees and mud daubers. Obtain expert consultation on pesticide materials and treatment which will control insects without effects on building materials and meet goals for reduction or elimination of use of toxic chemicals. (Assume costs in regular maintenance program.)

2. Continue installation of storm drainage piping in tunnels to reduce attraction to insects (see Drainage section).

STRUCTURAL

Tunnels and Basement

1. On tunnel roof slab in front of Main House, restrict vehicle weight and payload to 6,000 pounds or less.

Provide means to prevent unauthorized vehicles from traveling over tunnel between Main House and swimming pool.

2. Replace timbers over opening at front porch of Main House with removable concrete cover, sealed to keep rainwater out of tunnel.

Materials and equipment		\$ 100
Labor	2 crew days (\$800/day)	<u>1,600</u>
		\$ 1,700

3. Replace expansion joints in tunnel slab roofs and walls, seal other joints.

Materials	150 ft. (\$5/ft.) + \$500	\$ 1,250
Labor	10 crew days (\$800/day)	<u>8,000</u>
		\$ 9,250

4. Treat exposed and exfoliated steel reinforcing in concrete elements, such as the tunnel roof slabs. Replace missing or deteriorated concrete.

Materials and equipment		\$ 3,000
Labor	20 crew days (\$800/day)	<u>16,000</u>
		\$ 19,000

5. Treat brick Great Hall fountain foundation (included in Brick section).

6. Provide removable sealed closure of incompletd tunnel ends, remove soil and debris, 3 locations.

Materials and equipment		\$ 1,000
Labor	3 (5 crew days) (\$800/day)	<u>12,000</u>
		\$ 13,000

7. On main tunnel drainage and utility trenches, replace missing or deteriorated cover planks.

Materials		\$ 400
Labor	3 crew days (\$500/day)	<u>1,500</u>
		\$ 1,900

Flag Tower

1. Reanchor exterior ladder rungs. Apply abrasive safety coating to rungs.

Materials and equipment	\$1000 + \$200	\$ 1,200
Labor	15 crew days (\$500/day)	<u>7,500</u>
		\$ 8,700

2. Provide safety climbing pole at exterior ladder, with safety harness.

Design, materials and fabrication		\$ 10,000
Labor	5 crew days (\$500/day)	<u>2,500</u>
		\$ 12,500

Exterior Features

1. Treat concrete slab at rear of Annex (from rear exit at Guest Bedrooms) to stop concrete deterioration.

Materials		\$ 200
Labor	5 crew days (\$350/day)	<u>1,750</u>
		\$ 1,950

2. Apply sealant to exposed exterior concrete slabs over tunnels. (Also see Drainage section).

Materials	\$200 + (4200 sq. ft./400) (\$20)	\$ 410
Labor	5 crew days (\$500/day)	<u>2,500</u>
		\$ 2,910

3. Restore eroded grades around foundations and exterior slabs (included in Drainage section).

Veranda Roof

1. Restore veranda roof, Main House front porch.

Equipment		\$ 2,500
Dismantle existing roof	10 crew days (\$800/day)	8,000
Refinish supports	\$100 + 10 crew days (\$500/day)	5,100
Replace wood deck	495 sq. ft. (\$12/sq. ft.)	5,940
Replace roofing	5 squares (\$1200/sq.)	<u>6,000</u>
		\$ 27,540

Bridge

1. Limit bridge loading as recommended, including maximum of 19 people in tour groups. (See memorandum in Appendix of Structural section). [Limit policy adopted and instituted in 1990.]

General

1. Repair deterioration and failures at Flag Tower concrete door hinges and steel stair connection to landing.

Materials	2 (\$200) + \$300	\$ 700
Labor	15 crew days (\$500/day)	<u>7,500</u>
		\$ 8,200

2. Repair plaster and cork lining assembly where deteriorated or it has failed in Refrigeration and Freezer Rooms, Annex.

Remove and reinstall historic equipment		
	20 crew days (\$800/day)	\$ 16,000
Remove deteriorated material (3,800 sq. ft.)		
	10 crew days (\$800/day)	8,000
Replace cork lining	3,800 sq. ft. (\$3/sq. ft.)	11,400
Replaster	(2,900 sq. ft./9) (\$70/sq. yd.)	22,556
Replace concrete floor	[(900 sq.ft.) (0.33 ft.)/27] (\$1000/sq. yd.)	<u>11,000</u>
		\$ 68,956

3. Replace/repair bottom stair support framing, Main House stair, first to second floor.

Shoring and materials		\$ 500
Labor	8 crew days (\$800/day)	<u>6,400</u>
		\$ 6,900

4. Treat exposed wooden decks, such as balcony floors, Main House, with water repellant.

Materials		\$ 50
Labor	2 crew days (\$350/day)	<u>700</u>
		\$ 750

SEISMIC

1. Continue seismic monitoring.

CONCRETE

1. Monitor Main House basement walls for moisture leakage and dampness (see Drainage section).

2. Modify drain pipes in main tunnel roof slab between Main House and swimming pool to prevent ponding and concrete deterioration. Connect drains to tunnel drain piping. (See Drainage section.)

3. Replace and seal expansion joints in concrete slabs. Treat rusted and exfoliated reinforcing and replace missing or deteriorated concrete. Repair miscellaneous concrete damage in tunnels, and repair or seal cracks or joints. (See Structural section.)

4. Provide moisture sealant on exposed concrete slabs. Maintain the historic unfinished appearance. (See Structural section).

5. Repair concrete slab at rear of Annex, including treatment of exposed rusted reinforcing and patch concrete, and provide new protective topping. (See Structural section.)

6. Replace the safety barrier along the swimming pool and repair the holes previously bored in the tunnel top slab.

Repair/clean/treat existing gutter drain pipes	40 (\$150)	\$ 6,000
New railing	800 ft. (\$30/ft.)	24,000
Remove existing barrier and patch concrete	\$400 + \$1,600	<u>2,000</u>
		\$ 32,000

7. Provide protective treatment of exposed steel concrete reinforcing or other exposed steel which remains from the historic uncompleted construction.

Materials and equipment		\$ 1,000
Labor	10 crew days (\$800/day)	<u>8,000</u>
		\$ 9,000

BRICK

1. Inspect and test brick and mortar strength and stability utilizing core borings and lab testing. Determine treatment requirements.

Inspection, lab tests, report	\$ 5,000
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2. Assuming consolidation is required, carry out treatment. Replace/repair deteriorated surface brick and mortar as required.

Contract	[Crew: \$5000 + P.D.: 1100 + Mat: 500 + Test: 1000] [O&P: 2.4] + Rep: 800	\$ 19,040
		use \$ 20,000

PREPARATION FOR INTERIOR WORK

For equivalent of 24 rooms, furniture moving to and from storage	24 [3 people(\$120/day)(5 days) + 5 crew days per space(\$800/day)]	\$139,200
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If divided into 10 annual units = \$ 13,920/year; or allocate proportionately to costs for wood repairs, plaster repairs, tile repairs, window work, and any other work for that space.

STUCCO AND PLASTER

1. Continue on-going park based stucco research.
2. Provide stabilization or reattachment of delaminated or severely damaged stucco on a limited basis only for safety or temporary protective concerns.
3. Replace delaminated and damaged stucco and plaster. Areas of highest priority are portions of the Annex north wall and south walls, ceiling and east wall of Alcove. (The Annex Freezer and Refrigerator Rooms are included in the Structural section and are lower priority.

Annex exterior, north and south walls and alcove:

Remove deteriorated stucco	(2800 sq. ft.) (\$2.50/sq. ft.)	\$ 7,000
Preparation and repairs	\$500 + 10 crew days (\$800/day)	8,500
Treat existing waterproofing primer and primer sealer)	(2,300 sq. ft.) (\$ 5/sq. ft.)	11,500
Remove and replace insulex (insulation)	(500 sq. ft.)(\$ 1/sq. ft.)	500
Remove and replace brick and hollow clay tile	(500 sq. ft.)(\$ 7 + \$20/sq. ft.)	13,500
Replacement stucco	(2800 sq. ft./9)(\$70/sq. yd.)	<u>\$ 21,770</u> \$ 62,770
General exterior stucco repairs	\$2000 + 60 crew days (\$800/day)	\$ 50,000
General interior plaster repairs [unit = deficiency; 1 crew hr = 5 hrs total time]	250 units (5 crew hrs) (\$100/crew hr)	\$ 125,000

4. Repair and eliminate sources of moisture intrusion, such as leakage and poor drainage of the Annex second floor decks, the Lanai fountain and drains, and the Bridge. (See Annex Second Floor Deck, Fountains and Tile sections).

5. Provide protective maintenance of large stucco cracks. (20 crew days)(\$500/day) \$ 10,000

6. Install expansion joints at selected locations: Bridge to building intersections, intersection of Patio walls with buildings (inside corners only), and at back wall of Annex.

Materials	Approx. 170 linear feet (\$5/ft.)	\$ 850
Labor	10 crew days (\$800/day)	<u>8,000</u>
		\$ 8,850

7. Clean exterior stucco only when needed and with low pressure water. (Do not attempt to remove rust stains). Clean interior plaster gently with vacuum. (Part of normal maintenance.)

8. Provide Munsell color record of original stucco and plaster colors. Use original colors for major sections of replacement stucco. For small repairs, match the existing adjacent stucco color. (See Color section.)

TILE

Exterior Tile

1. Replace missing and damaged roofing tile with matching reproduction or salvaged tile. Replace/repair setting mortar as required. Includes obtaining equipment for protection of roofing and working platforms to minimize additional roof loading.

Equipment	Scaffolding with winch operated work platform	\$ 25,000
Roofing replacement/repairs	25% (8500 sq. ft.) = 2125 sq. ft., use 2500 sq. ft.	
Replacement tile	2.5 squares (\$1500/sq.)	3,750
Labor	80 crew days (\$800/day)	<u>64,000</u>
		\$ 92,750

2. Inspect roofing tile, especially at eaves, at least annually and after major storms.

3. RegROUT Patio tile as required to prevent grout loss, loose tile, and deterioration of setting mortar and substrate materials.

Replacement tile	500 sq. ft. (\$12/sq. ft.)	\$ 6,000
RegROUTING	(Patio = 3125 sq. ft.) + (Alcove = 1216 sq. ft.) + (Veranda = 372 sq. ft.) + (Porches = 927 sq. ft.) = 5640 sq. ft. (1 crew day/100 sq. ft.) (\$800/day)	<u>45,120</u>
		\$ 51,120

4. Clean and repair the drains in the Patio planter boxes as required; repair concrete where required and renew or add waterproofing; reduce the soil level in the planter boxes; regrout planter box edging tile; renew the grout trim between the patio tile and planter box edging tile; replace deteriorated planter box edging tiles when necessary and available.

Remove/replace soil	5 crew days (\$500/day)	\$ 2,500
Repair/replace drains	Assume 9 [\$50 + (\$500/day)]	4,950
Repair concrete as reqd	\$200 + 9 (1/2 day) (\$500/day)	2,450
Waterproof concrete	\$500 + 2 days (\$500/day)	1,500
Repair/replace/regrout tile edging	\$300 + 3 crew days (\$650/day)	<u>2,250</u>
		\$ 13,650

5. At the Patio/Annex alcove intersection, take up the paving tile as necessary, determine the requirements for expansion joints and install as required, reset the drain body as required, and reset and regrout the tile paving.

Remove/reset paving tile; 256 sq. ft.	5 crew days (\$800/day)	\$ 4,000
Expansion joint/s	\$100 + 3 crew days (\$500)	1,600
Reset drain		<u>500</u>
		\$ 6,100

6. Point the joint at the underside of projecting tile on porches and steps where the concrete wall or riser was not tiled to reduce water penetration into the tile setting bed. At porches, maintain grade a minimum of 2 inches below this joint.

5 crew days (\$800/day)	\$ 4,000
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7. Renew and maintain joint grouting of wall and parapet copings, making sure tiles are firmly set. Regrout bridge tilework. Install mortar cap protection at vent location in parapet on south balcony of Annex.

10 crew days (\$800/day)	\$ 8,000
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8. In conjunction with Annex stucco and Lanai fountain repair projects, reset the tile of the Lanai and balcony decks to provide positive drainage away from walls and parapets and to drains.

Take up tile deck and tile wall base trim (all good tile to be reused)	1365 sq. ft. at 100 sq. ft./day; 14 days (\$800/day)	\$ 11,200
Clean mortar off tile	14 days (\$800/day)	\$ 11,200

Remove old mortar setting bed from concrete slab	14 days (\$800/day)	\$ 11,200
Install moisture barrier membrane on concrete slab; provide integrated membrane at base of walls; joint seal may be needed for cracks in concrete slab; a bonding agent may be needed for the tile setting bed	1365 sq. ft. (\$5/sq. ft.)	\$ 6,825
Repair/replace drains (3 scuppers and Lanai drain to north building wall -- requires creating access opening)	3 (\$500) + \$100 + 3 (\$800)	\$ 4,000
Repair/replace Lanai fountain plumbing system	\$150 + 5 (\$500)	\$ 2,650
Cut wall stucco where necessary for new pitches of tile deck to accommodate tile base	1 crew day (\$500/day)	\$ 500
Install new mortar setting bed at new grades for positive drainage pattern	1365 sq. ft. (\$4/sq. ft.)	\$ 5,460
Reinstall tile deck and wall base trim tile, replacing broken and eroded or pitted tiles	200 sq. ft. (\$12/sq. ft.) + 14 days (\$800/day)	\$ 13,600
Repair/replace "travertine" style wall base where required	\$100 + 4 days (\$500/day)	2,100
Replace/restore fountain tilework	\$5000 + 5 days (\$500/day)	<u>\$ 7,500</u> \$ 76,235

9. It is noted that all tile joint grouting renewal and sound tile system maintenance is also prevention of safety hazards which would otherwise exist with broken and missing grout and loose tiles.

Interior Tile

1. RegROUT floor tile, reset loose tile as necessary, in heavy foot traffic locations before deficiencies cause tile breakage or a safety hazard. The location that should be repaired in the near future is on the balcony of the Great Hall near the doorway to the bridge.

2. Replace deteriorated, broken and missing grouting. Replace broken or missing tiles using existing stock when available provided that such stock is greater than the established minimum samples to be maintained in the collection.

3. Replacement of cracked, chipped or pitted tiles is not recommended unless they become so damaged as to create a safety hazard or cause deterioration of adjacent tilework. Patching of chipped or pitted tile is not recommended.

Items 1 – 3, aggregate	9500 sq. ft. (1 crew day/100 sq. ft.) (\$800/day)	\$ 76,000
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ANNEX SECOND FLOOR PATIO

1. Take up tile deck and tile wall base trim, seal concrete slab with a waterproof membrane (liquid applied type), repair/replace deck drains, and reinstall tile providing a carefully controlled setting bed to establish positive drainage for all deck areas. Repair/replace Lanai fountain plumbing system. Replace/restore fountain tilework. (See Tile above.)

OBSERVATION TOWER DECK

Preparation, procurement, mobilization, supervision	(10 days) (\$250/day)	\$ 2,500
Opening protection	Materials Labor (2 days) (\$500/day)	\$ 50 1,000
Flooring removal	(2 days) (\$350/day)	700
White lead removal	(1 day) (\$500/day)	500
Disposal		500
Flashing removal/salvage	(2 days) (\$350/day)	700
Subfloor removal	(2 days) (\$350/day)	700
Framing removal	(2 days) (\$500/day)	1,000
Framing replacement	Materials Labor (3 days) (\$500/day)	300 1,500
Subfloor replacement	Materials Labor (2 days) (\$350/day)	100 700
New moisture barrier	Material Labor (3 days) (\$350/day)	200 700
New flooring	Material Labor (2 days) (\$350/day)	200 700

Coating	Material	30
	Labor (2 days) (\$155/day)	310
Miscellaneous repairs, materials		<u>500</u>
		\$ 12,890
	Use	\$12,900

WOOD

1. Clean wood with gentle means appropriate for the type of finish.
2. Continue on-going park based wood maintenance, restoration and repair, giving priority to exterior wood elements subject to high weathering and damaged wood subject to further damage by use. Provide record of materials, methods and finishes used.

Exterior wood restoration/ repair	\$8,000 materials + 320 crew days (\$800/day)	\$264,000
Interior wood restoration/repair, ca. 372 treatable deficiencies	372 [\$25 materials + 1 crew day (\$800/day)]	\$306,900

3. Provide climate control for preservation of wood and all other fabric of the structures and furnishings. (See Climate Control section).

4. Remove and control conditions which induce rot or insect damage (maintaining grade to wood separation, insect control, etc.).

10 crew days (\$650/day)	\$ 6,500
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5. Provide for analysis of wood color and finish systems and Munsell color record by conservator/specialist. (See Color section.)

METALS AND GLASS

1. Obtain a metals finishes and color conservator for an analysis and record of metal finishes and colors. (See Color section.)

2. Restore and refinish deteriorated door hardware finishes. Repair malfunctioning, damaged or worn components.

45 (\$20) + 45 doors (3 units/door) (1 day/unit) (\$500/day)	\$ 68,400
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3. Refinish exterior metal windows, reglaze as required. Refinish metal grills and shutter hardware which has lost its finish.

Materials	102 (\$15)	\$ 1,530
	102 window or grill units (2 days/unit) (\$350/day)	\$ 71,400
Shutter hardware units	62 units (\$500)	<u>31,000</u>
		\$ 103,930

4. Refinish weathered exterior structural elements such as the decorative supports of the Main House front porch veranda roof (see Structural section) and other structural or architectural elements having deteriorated finishes.

8 units [\$50 + 5 days (\$500/day)] \$ 20,400

5. Repair and refinish exterior light fixtures as required.

24 units (\$850) \$ 20,400

COLOR

When treatment of wood, metals or other materials is undertaken, part of the preparatory analysis is to determine the aspects of the finish system: materials that were used, the colors, how it was done, and the modern materials and techniques needed for restoration. Both on-site and lab testing will be required. A color analysis should be undertaken for both wood and metal elements as recommended in those sections of this report.

(\$55/hr.) (8 hrs.) (90 days) + \$116,424
 (\$55) (30) + (\$35) (30) +
 \$800 + \$1000 = \$44,100 (2.4) +
 10%

ENVIRONMENTAL CONTROLS

1. Building envelope weatherization (window and door weatherstripping).

Window weatherstripping	90 units (\$75)	\$ 6,750
Door weatherstripping	45 units (\$100)	<u>4,500</u>
		\$ 11,250
10% contingencies		<u>1,125</u>
		\$ 12,375

2. Existing heating system improvements \$ 5,449

3. Fire isolation doors and dampers 13,971

4. New comprehensive climate control system	280,064
10% contingencies	<u>28,000</u>
	\$339,859

FIRE SUPPRESSION

Feasibility analysis	\$ 35,000
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Design and construction costs are not included, pending the results of a feasibility analysis.

PLUMBING

Deactivate and isolate unused sections of plumbing systems.

Materials	\$ 500
Labor (10 crew days) (\$500/day)	<u>5,000</u>
	\$ 5,500

FOUNTAINS

1. Restore Jasper Fountain, Great Hall

(Estimate for worst case option.) Replace stonework (requires locating source for matching stone and careful and highly detailed recording so appearance can be duplicated). Use water resistant grout in stonework (determine original grout color and duplicate). Use sealer on stonework.

\$6000 + 60 days (\$500/day)	\$ 36,000
------------------------------	-----------

Replace plumbing (use plastic in hidden and inaccessible locations). Add flow regulators and controls.

\$400 + 5 crew days (\$350/day)	2,150
---------------------------------	-------

Replace liners, moisture barriers (provide additional waterproof linings, use copper at visible portion plus additional liner).

60 sq. ft. (\$20/sq. ft.)	1,200
---------------------------	-------

Replace deteriorated structural/framing elements and substrates.

\$150 + 4 crew days (\$500/day)	2,150
---------------------------------	-------

Equipment and protective enclosure.	<u>1,000</u>
	\$ 42,500

Stabilize/repair brick and concrete foundation elements as required during or before the process. (See Brick).

Add costs for treated water and recirculating systems if selected in lieu of a "once-through" system. (See Climate Control analysis).

2. Restore Solarium fountain.

Restore wall tilework, retaining existing tile, replace grout. Restore basin tilework only as required. Use water resistant grout, duplicate original grout color and tooling.

\$250 + 15 crew days (\$500/day)	\$ 7,750
----------------------------------	----------

Replace plumbing (use plastic in hidden and inaccessible locations). Add flow regulators and controls.

\$400 + 5 crew days (\$350/day)	2,150
---------------------------------	-------

Replace liners, moisture barriers (provide additional waterproof linings).

24 sq. ft. (\$20/sq. ft.)	480
---------------------------	-----

Replace deteriorated structural/framing elements and substrates.

\$150 + 4 crew days (\$500/day)	2,150
---------------------------------	-------

Replace damaged plaster.	\$200 + 5 crew days (\$500/day)	2,700
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Equipment and protective enclosure.	500
	\$ 15,730

Add costs for treated water and recirculating systems if selected in lieu of a "once-through" system. (See Climate Control analysis).

3. Restore Lanai Fountain (See Tile section above.)

Fountain and deck restoration should be done at same time.

Replace normally inaccessible plumbing with plastic pipe.

Duplicate and replace tilework. (Place original tile in artifact collection).

Match grout color and tooling and joint sizes to original. Use dense grout -- as water resistant as possible. Do not use joint sealants. Use and maintain tile/grout sealer. Add flow regulators and controls.

Add costs for treated water and recirculating systems if selected in lieu of a "once-through" system. (See Climate Control analysis).

4. Restore Entry Court Wishing Well

Replace all plumbing. Use plastic piping in normally inaccessible locations. Add flow regulators and controls.

\$400 + 5 days (\$350/day) \$ 2,150

Provide moisture barriers; add moisture barrier/block in center (round) well.

100 sq. ft. (\$10/sq. ft.) 1,000

Repair tilework and grout as necessary; replace tiles where required; replace tile grouting.

\$1200 + 20 days (\$500/day) 11,200

Clean and restore metal element, provide protective coating.

\$150 + 15 days (\$500/day) 7,650
\$ 22,000

Add costs for treated water and recirculating systems if selected in lieu of a "once-through" system. (See Climate Control analysis).

COURTYARD ARBOR

Reconstruction of the arbor would be consistent with the interpretation and restoration policy and thus supportable. However, it is suggested that it be regarded as a low priority, except as it may relate to one of the methods of improving building climate control to reduce temperatures within the buildings.

Preparation, equipment, barriers \$2000 + 10 days (\$800/day) \$ 10,000

Logs, connectors, installation 9000 BF (\$1500/MBF) + \$500 +
20 days (\$800/day) 30,000

\$40,000

ELECTRICAL SYSTEM

Electrical System Upgrade \$ 11,725

Future Emergency System (300 kw unit) 80,000

(Cost does not include structural work
to house or shield the system).

\$ 91,725

FIRE DETECTION AND SECURITY SYSTEMS

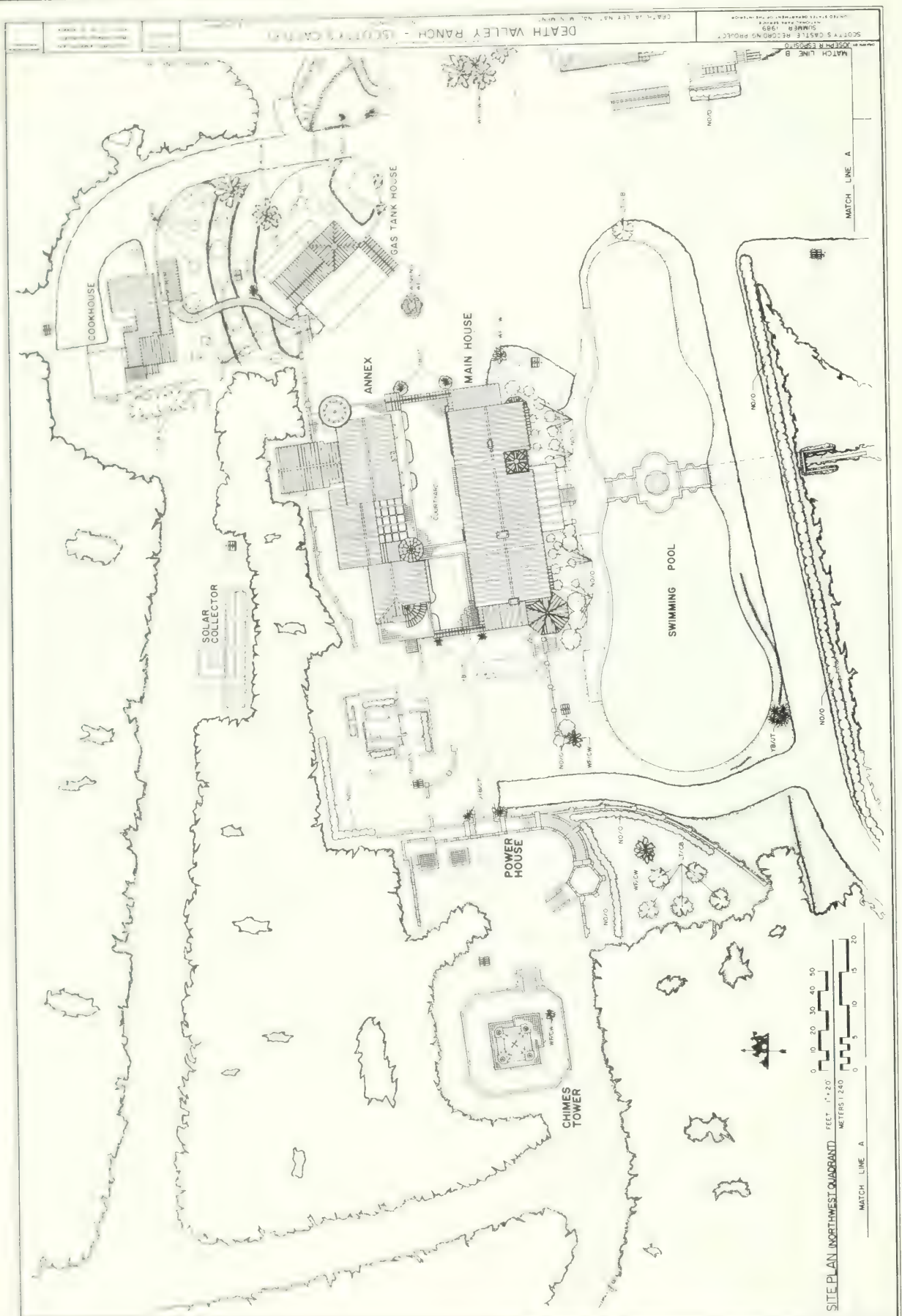
Upgrade fire detection and intrusion detection systems.

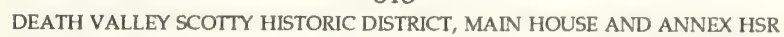
Equipment, materials		\$ 20,000
Installation	(60 crew days) (\$350/crew day)	<u>21,000</u>
		\$ 41,000

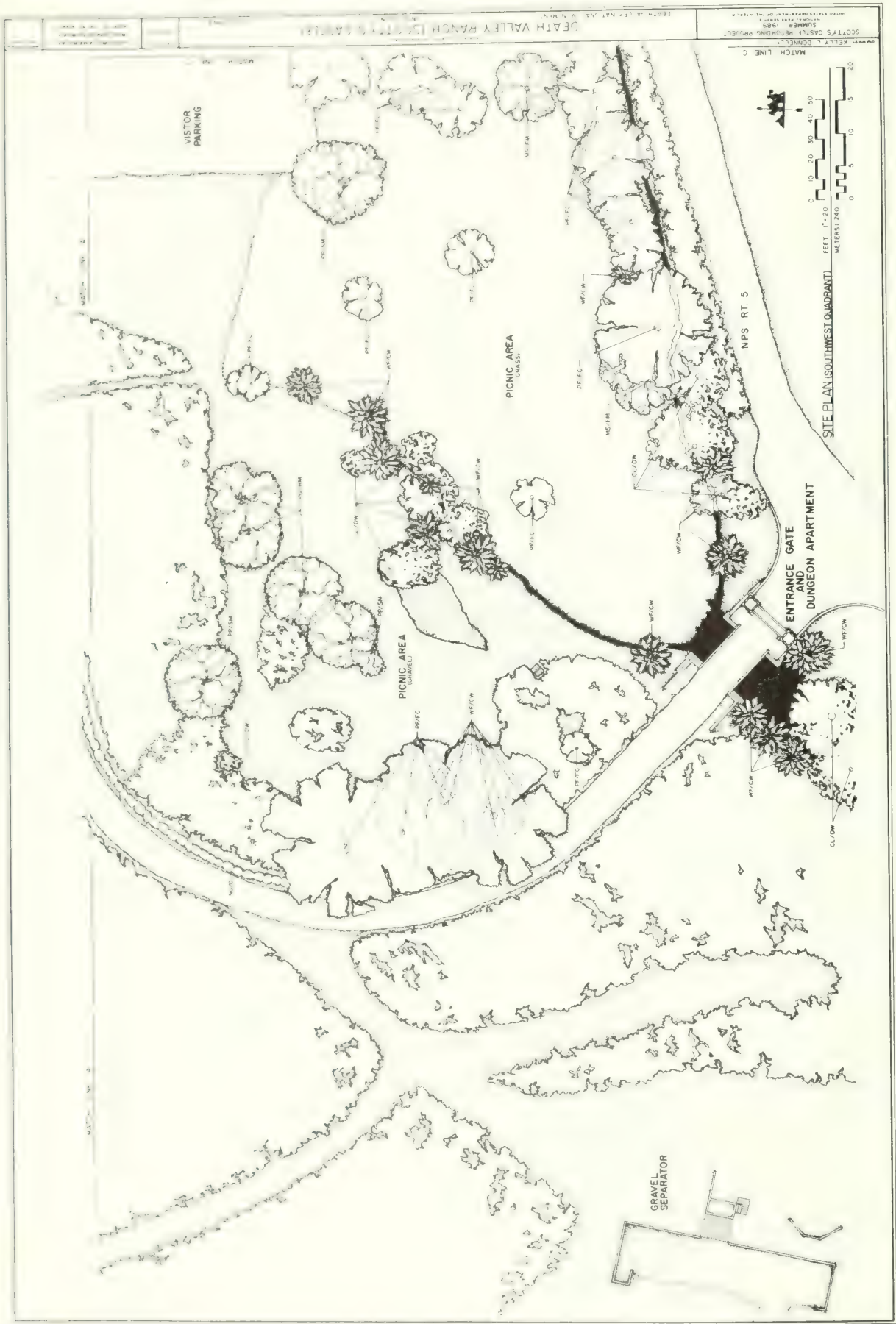
APPENDIX S, HISTORIC AMERICAN BUILDINGS SURVEY DRAWINGS







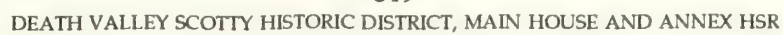


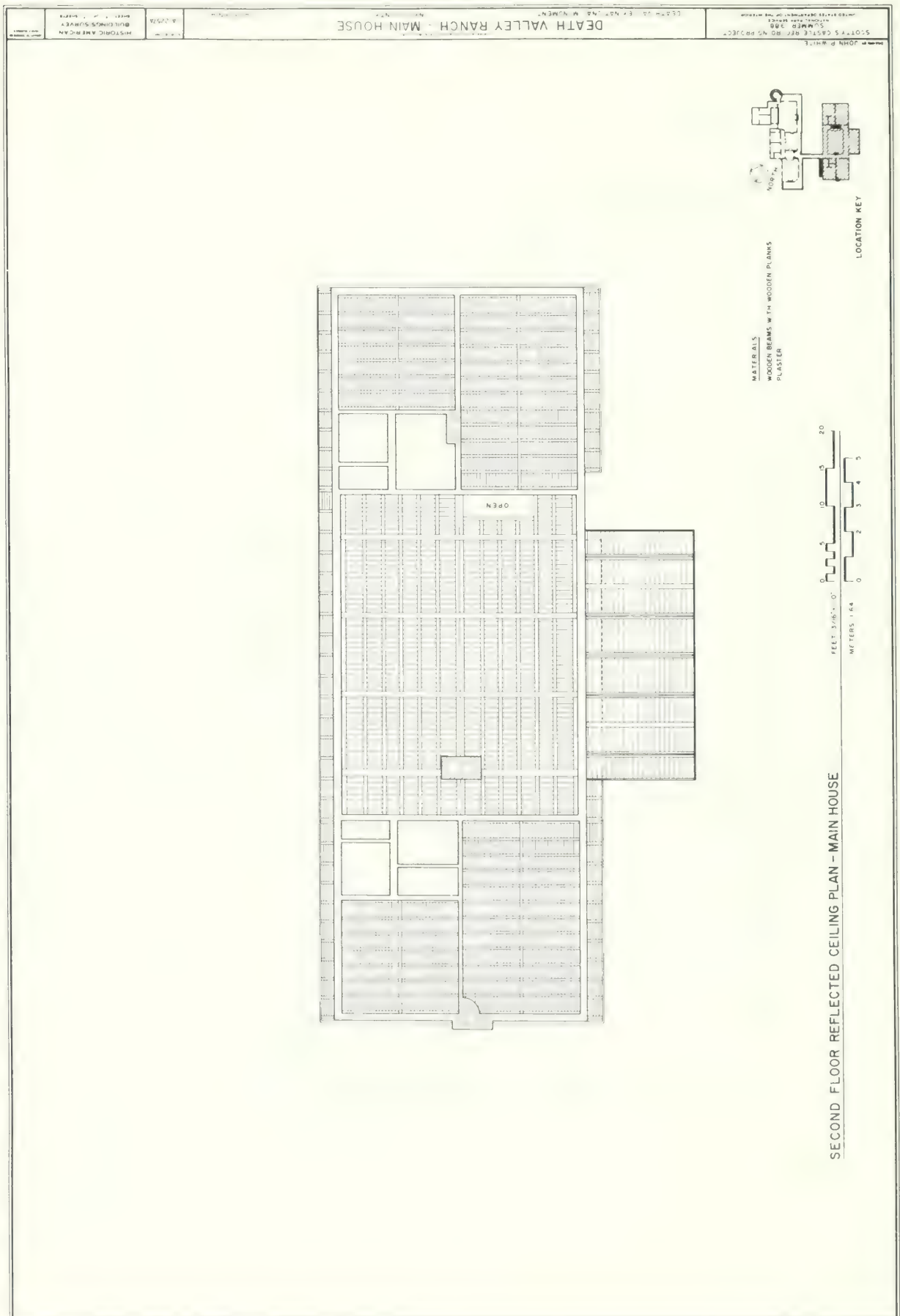




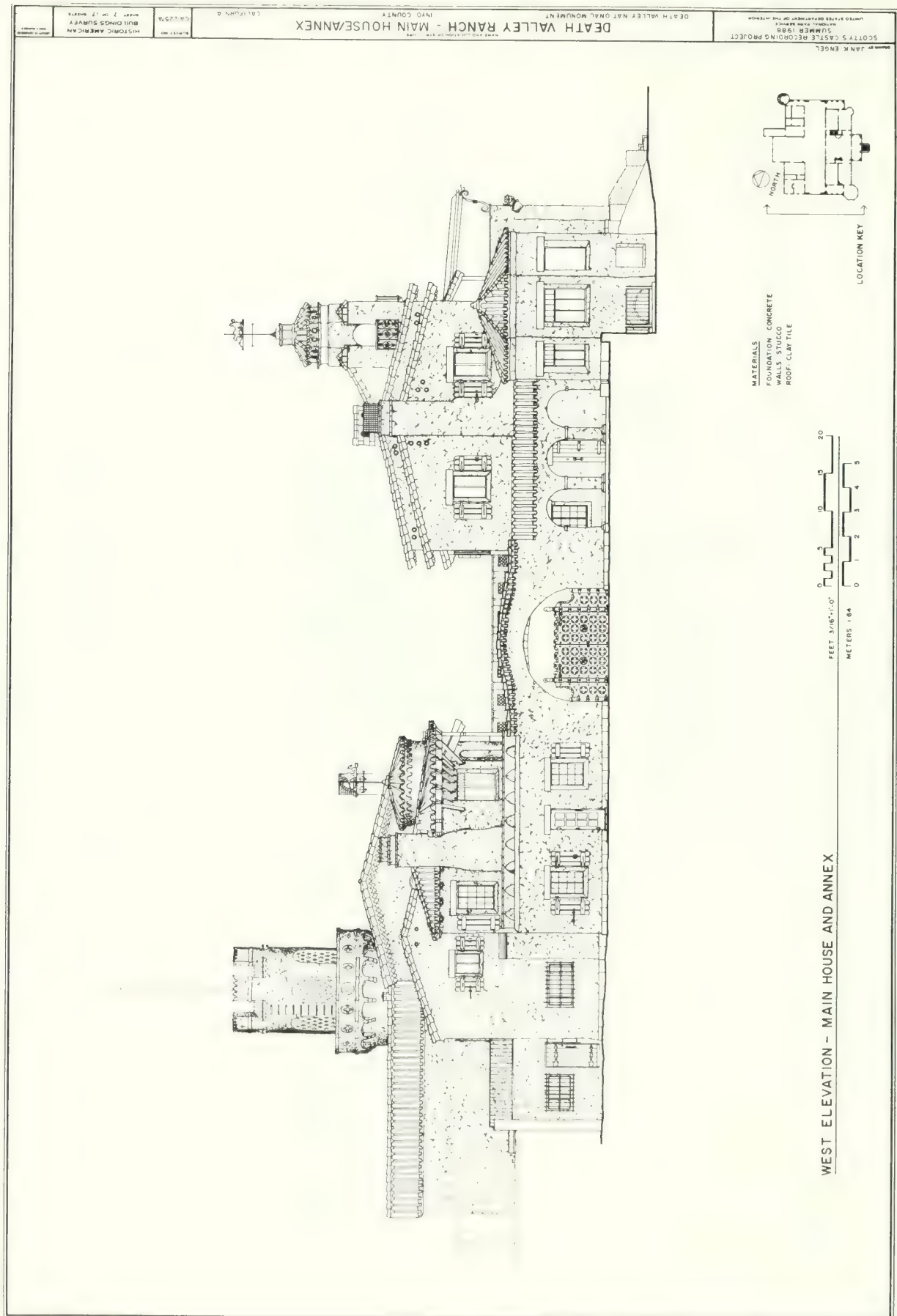


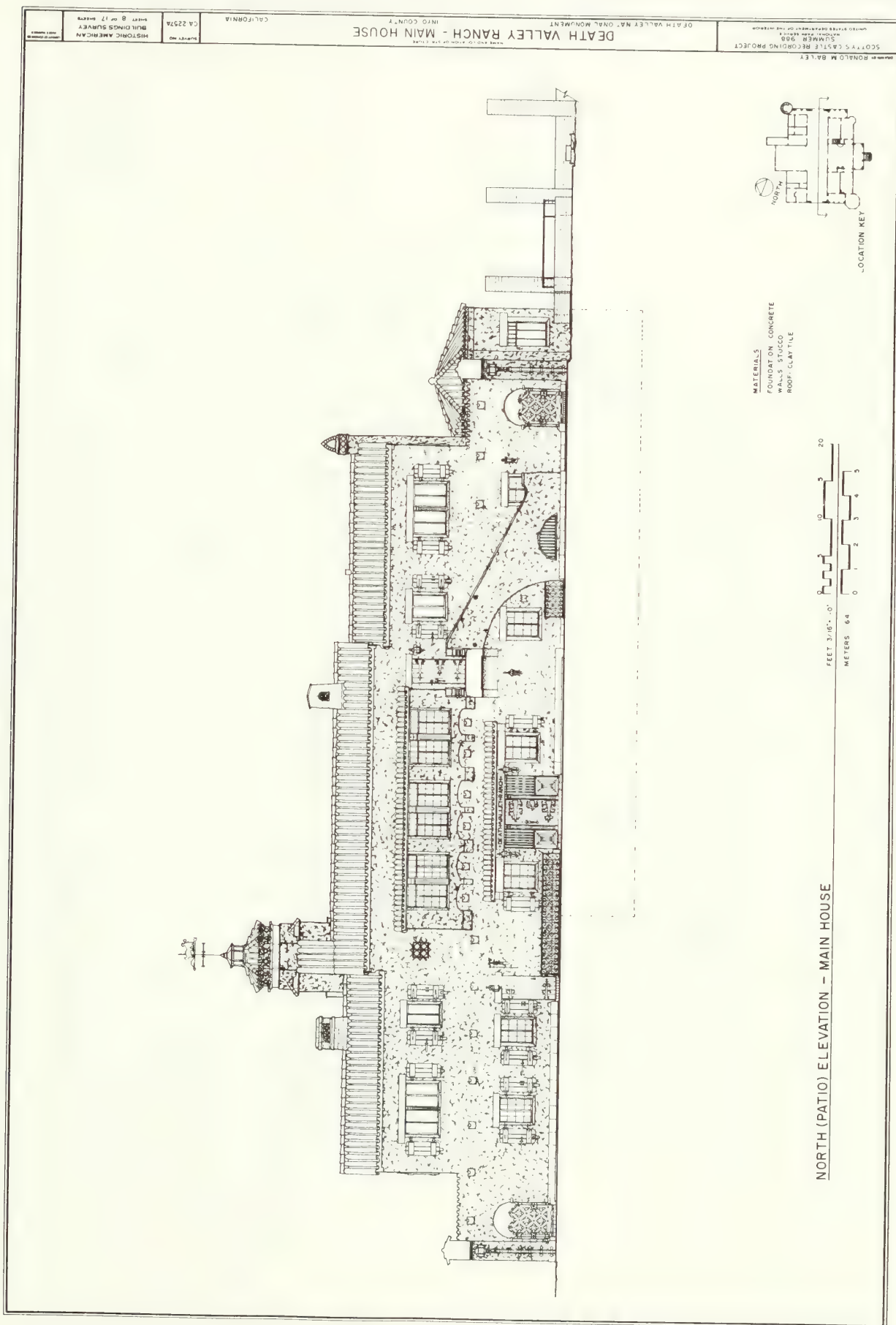


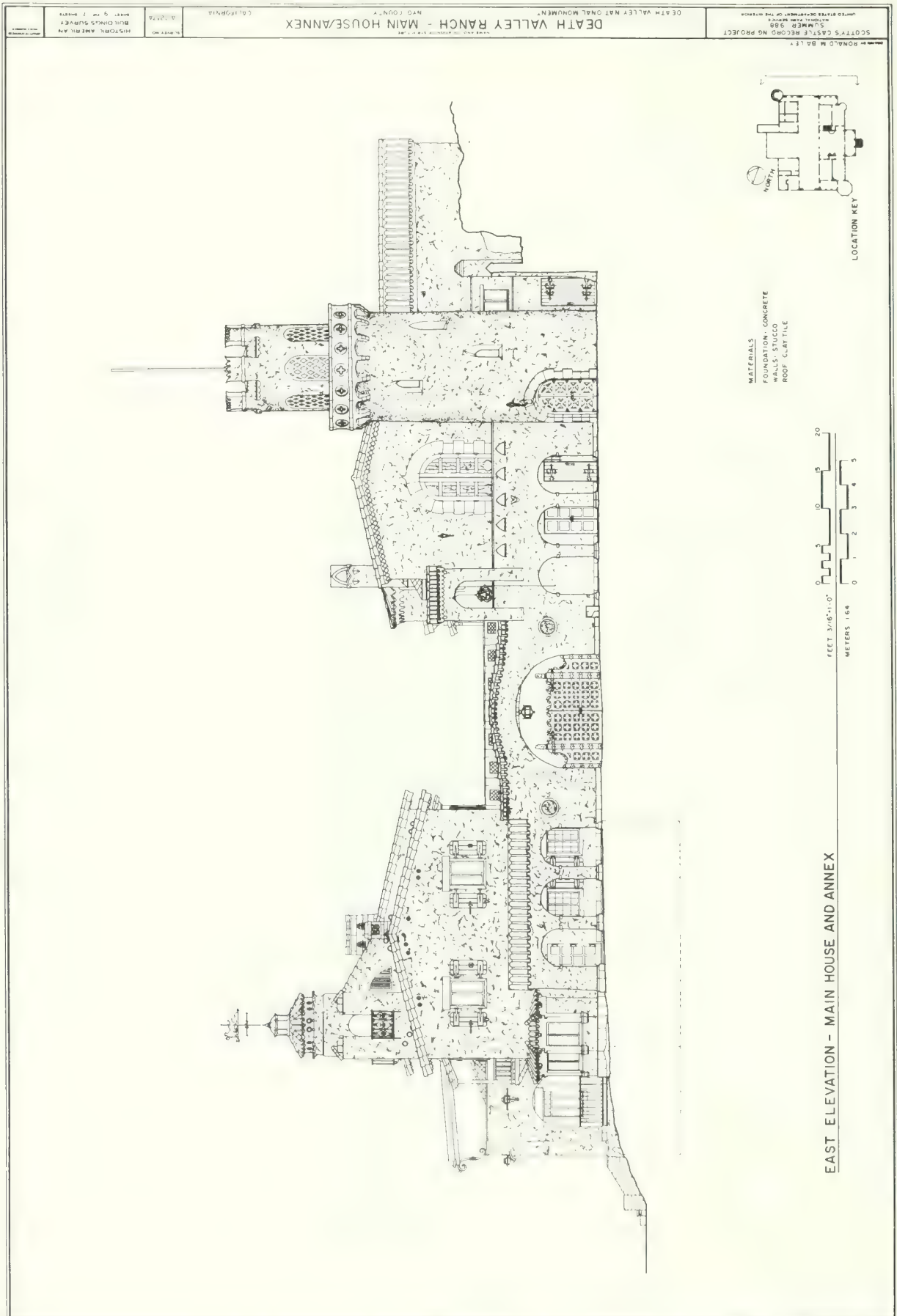


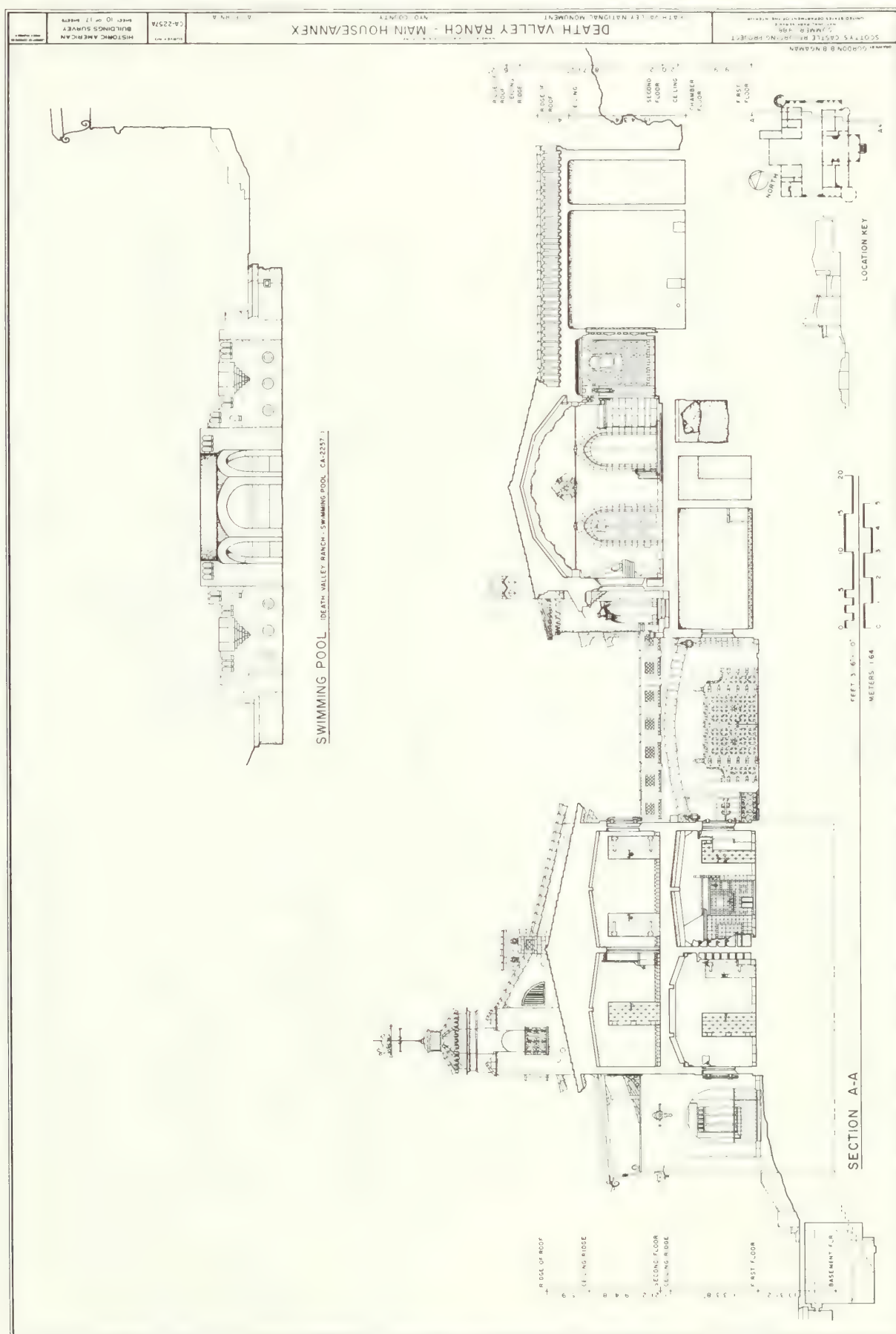


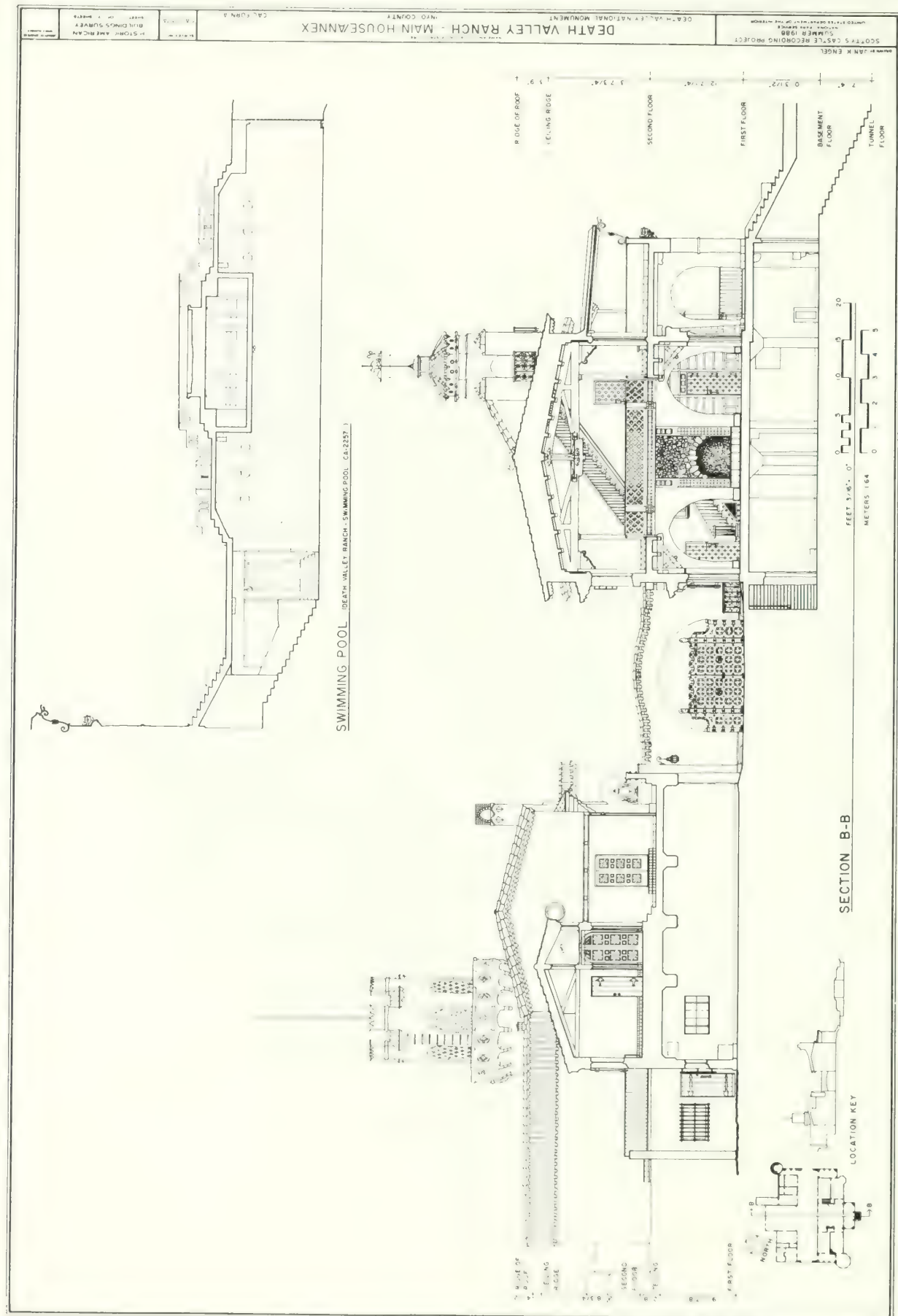


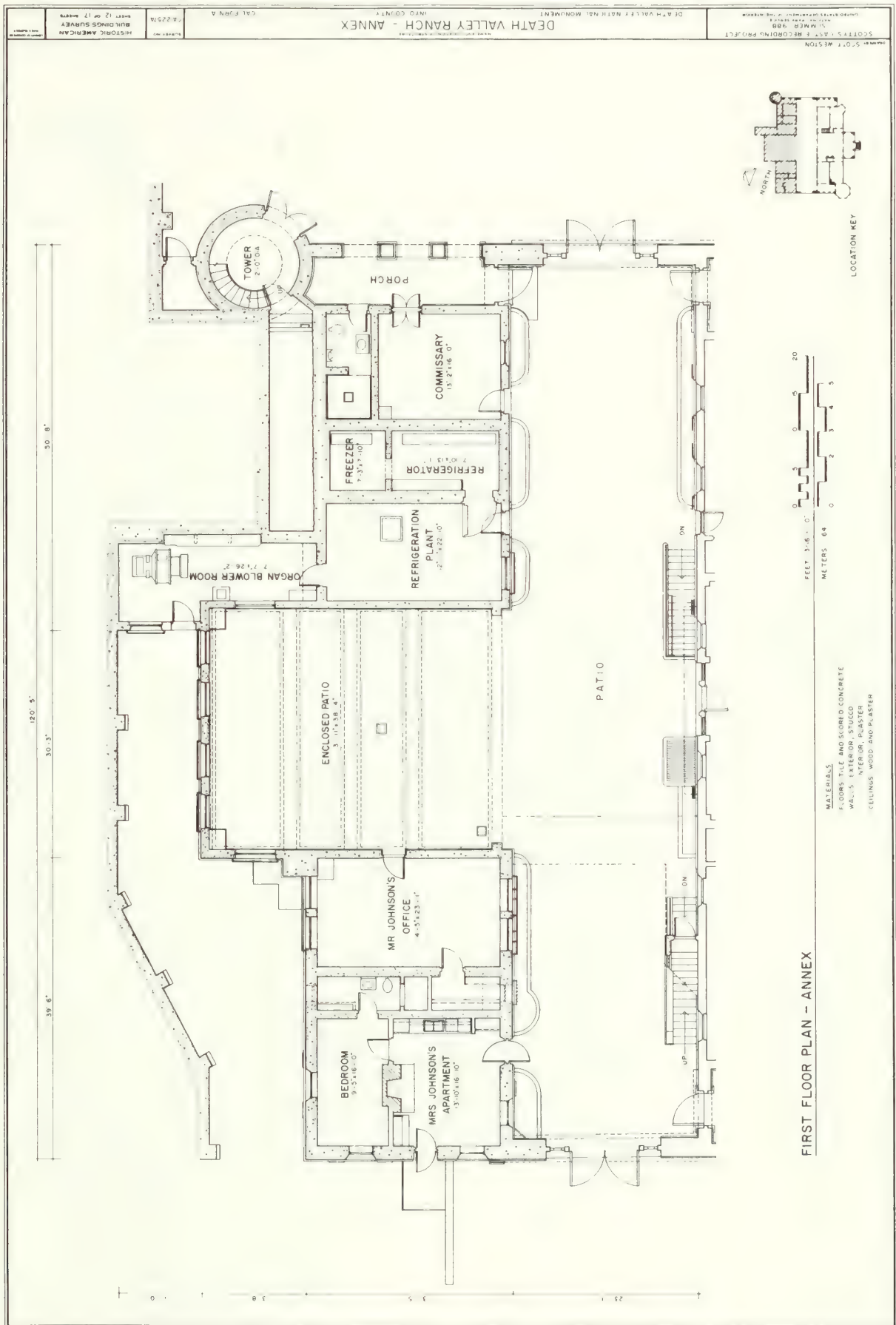


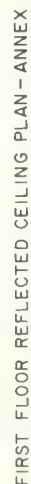


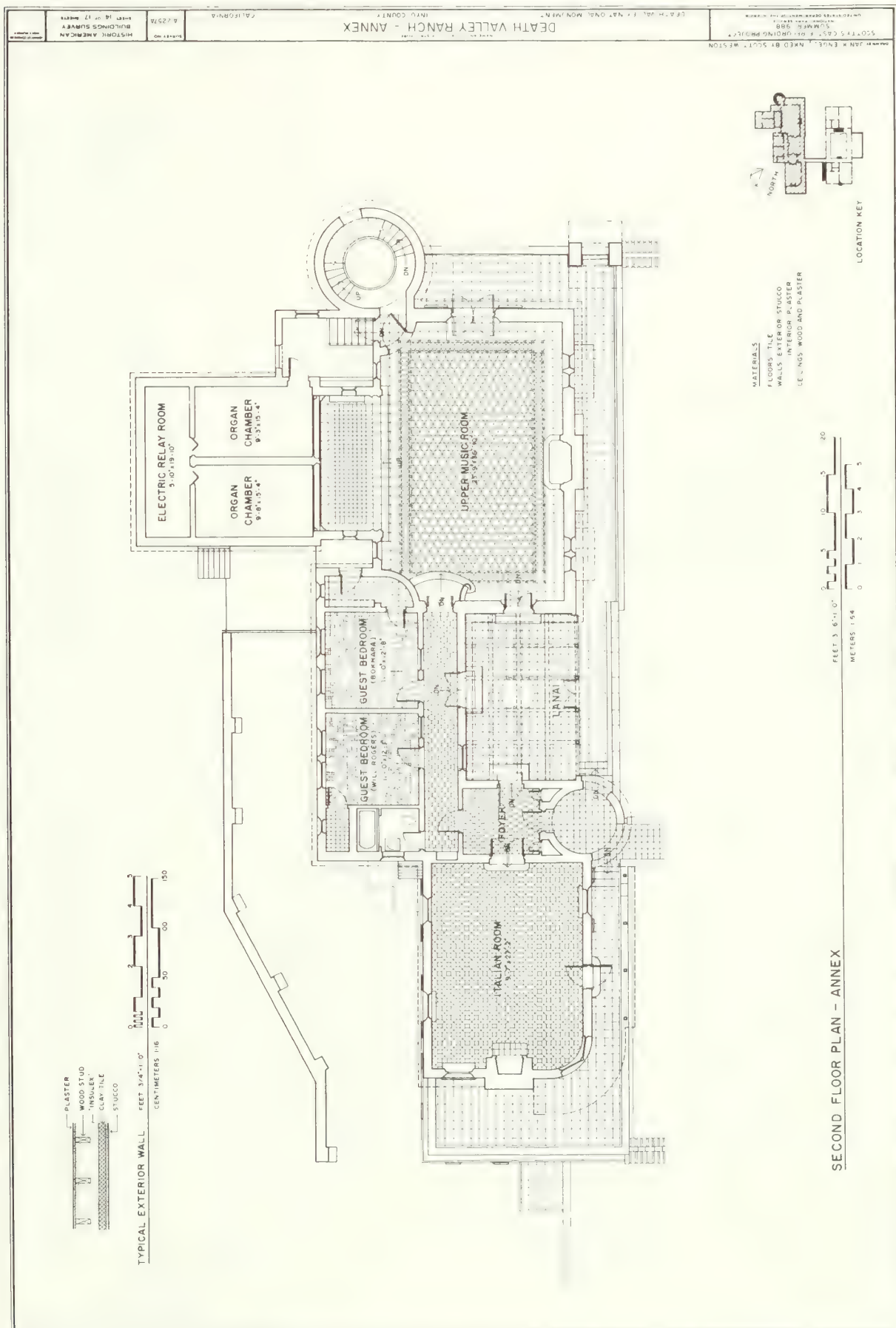


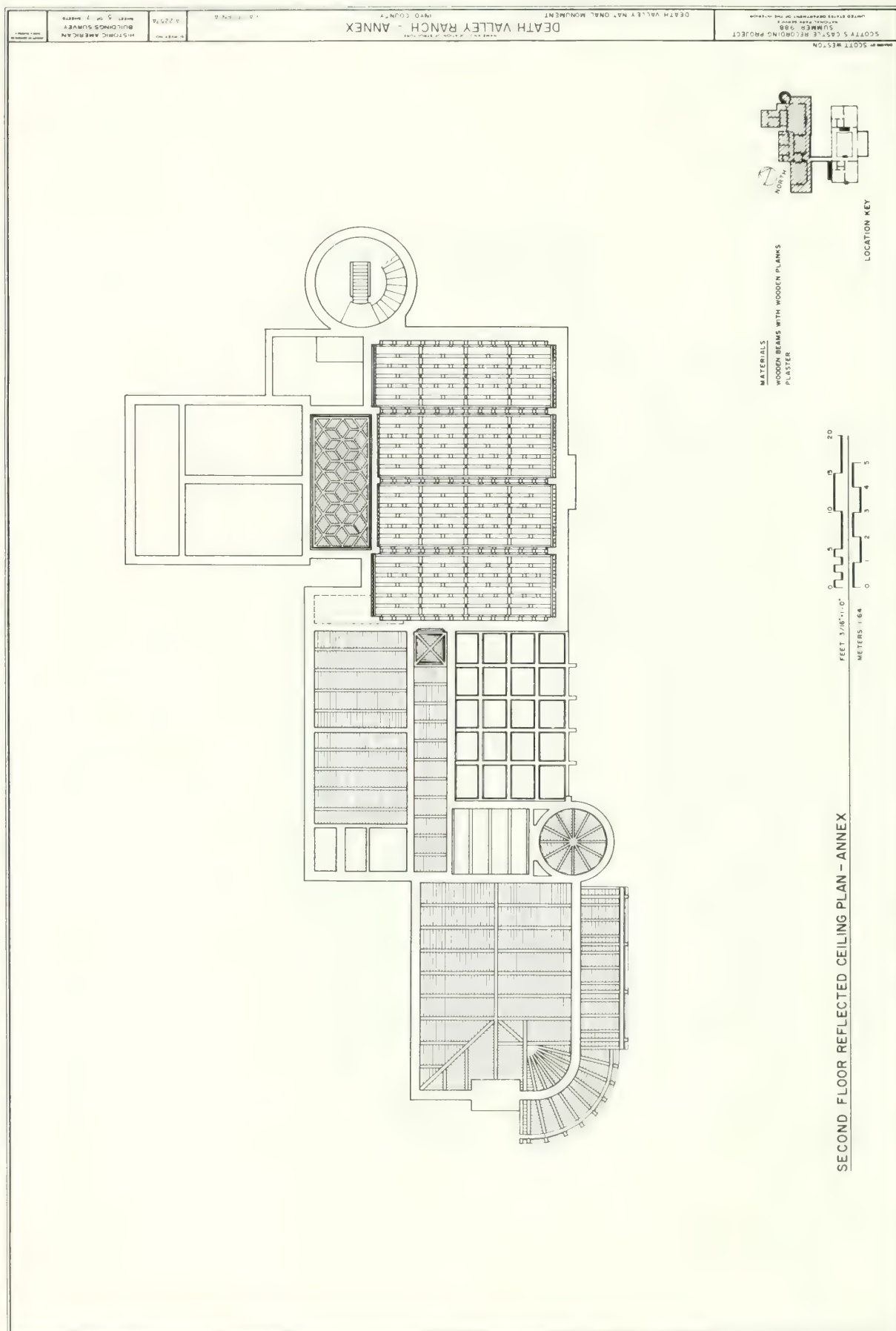


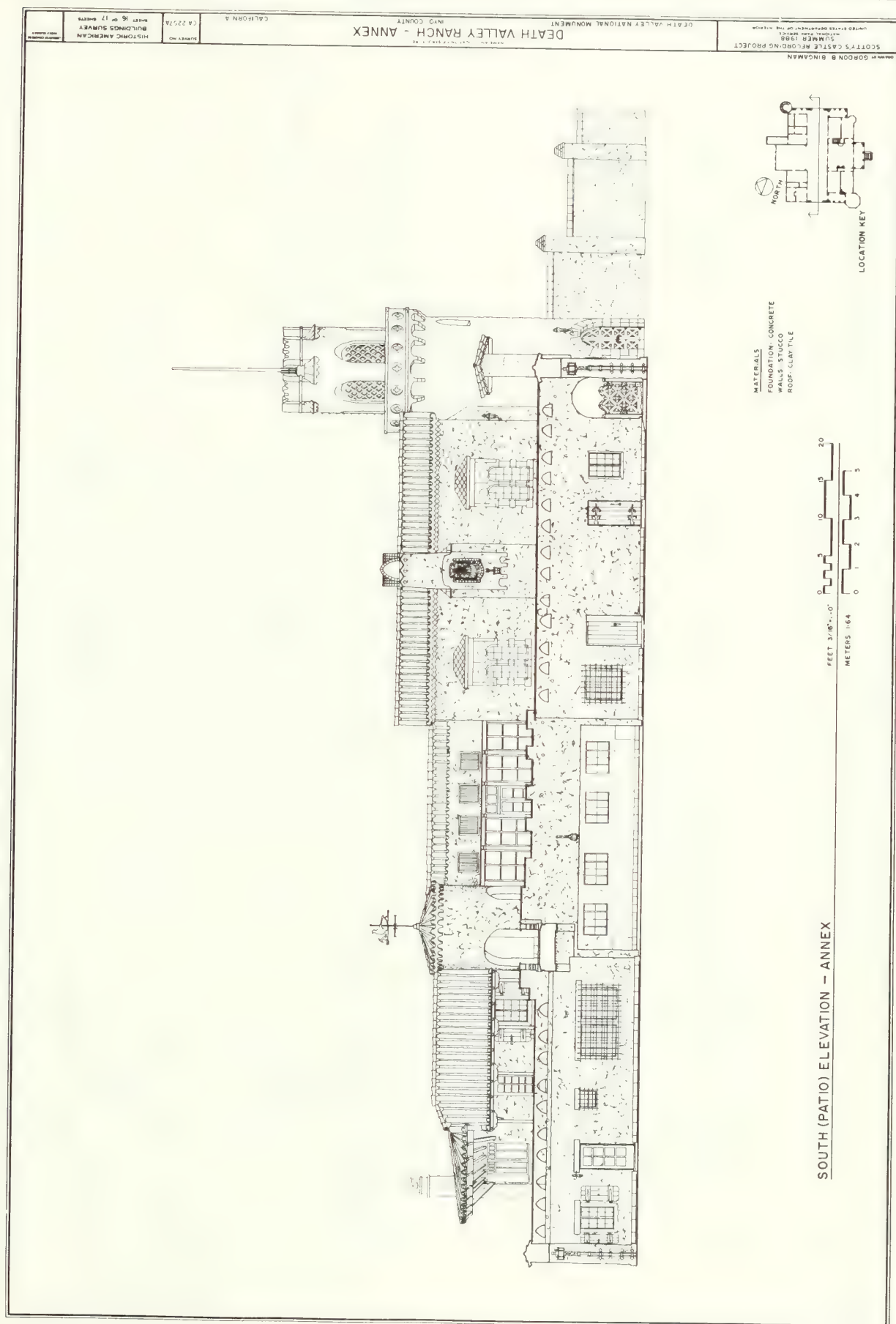


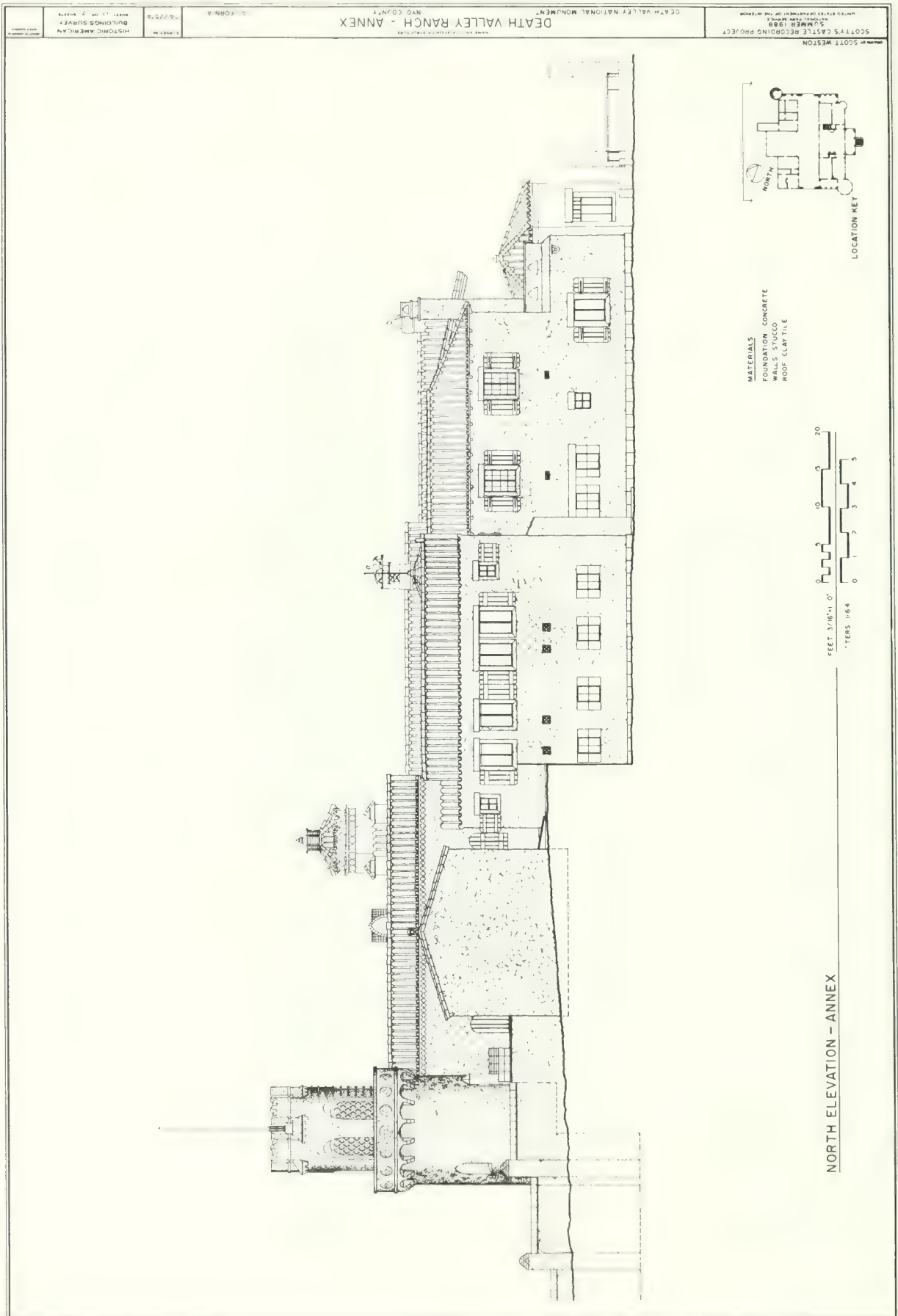


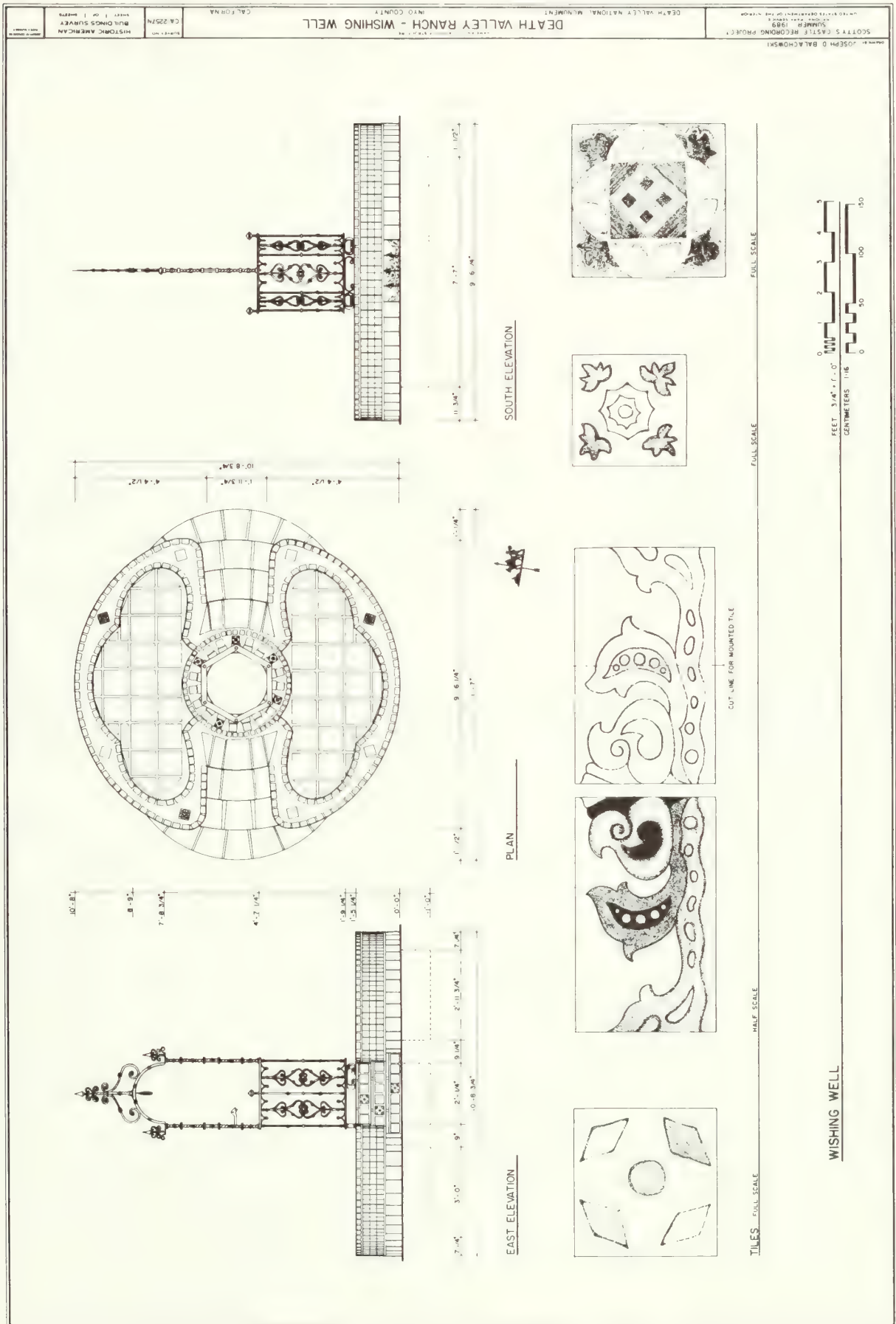












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Ludowici-Celadon, Inc., P. O. Box 69, New Lexington, Ohio, 43764.

Vande Hey Raleigh, 1665 Bohm Dr., Little Chute, Wis., 54140.

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SELECTED HISTORIC DRAWINGS

Drawings marked with an asterisk (*) are reproduced in this report.

Structural

- 1.* Foundation Plan, no date, Drawing No. 143/41029, sheet 4 of 41.
- 2.* Swimming pool concrete structural details, April 20, 1929, Drawing No. 143/41035, sheet 14 of 27.
- 3.* Pool and tunnel details, November 6, 1930 [?], Drawing No. 143/41030A, sheet 1 of 9.
- 4.* Pool details, no date, Drawing No. 143/41030A, sheet 2 of 9.
- 5.* Footing and Foundation Plan, August 13, 1926 [?], Drawing No. 143/41029A, sheet 2 of 9.
- 6.* Solarium Details, October 14, 1927 [?], Drawing No. 143/41029 [?], sheet 16 of 41.
- 7.* First Floor Plan, Main House, December 8, 1926, Drawing No. 143/41029, sheet 6 of 41.
- 8.* Second Floor Plan, Main House, [date illegible], Drawing No. 143/41029C, sheet 4 of [?].
- 9.* Longitudinal Section, Main House, August 1 and December 12, 1926 [?], Drawing No. 143/41029B, sheet 6 of 36.
- 10.* Sections, Main House, August 1, 1926, Drawing No. 143/41029A, sheet 9 of 9.
- 11.* Main House Section and Details, August 1 and December 10, 1926, Drawing No. 143/41029B, sheet 7 of 36.
- 12.* Main House details, [date illegible], Drawing No. 143/41029, sheet 31 of 41.
- 13.* Great Hall Trusses, July 27, 1926, Drawing No. 143/41029, sheet 21 of 41.
- 14.* Main House Observation Tower details, February 15, 1927, Drawing No. 143/41029, sheet 10 of 41.
- 15.* Upper Music Room Foundation Plan, December 31, 1927 or 1929 [?], Drawing No. 143/41031, sheet 99 of 159.
- 16.* Annex Elevations, 1927, Drawing No. 143/41029, sheet 28 of 41.
- 17.* Annex Plan and Elevation, First Floor, October 28 [or 29 ?], 1926, Drawing No. 143/41029, sheet 38 of 41, an M. R. Thompson drawing.
- 18.* Annex, Second Floor Plan and Sections, [no date or illegible], Drawing No. 143/41029, sheet 26 of 41.

- 19.* Upper Music Room Floor Plan, September 17, November 1 and December 31, 1927, Drawing No. 143/41031, sheet 104 of 159.
- 20.* Upper Music Room cross section, October 27 and November 15, 1927, Drawing No. 143/41031, sheet 98 of 159.
- 21.* Longitudinal Section, Upper Music Room, December 31, 1927, Drawing No. 143/41031 [also 143/41029 ?] , sheet 61 of 159.
- 22.* Details of the corner bay of the Italian Room, 1927, Drawing No. 143/41029, sheet 3 of 41.
- 23.* Upper Music Room Elevation and Details, no date, Drawing No. 143/41031, sheet 92 of 159.
- 24.* Upper Music Room Tower, no date, Drawing No. 143/41031, sheet 101 of 159.
- 25.* Flag Tower Details, no date, Drawing No. 143/41031, sheet 103 of 159.
- 26.* Bridge, 1927, Drawing No. 143/41029, sheet 27 of 41.

Stucco

- 1.* ".....Section through Typical Wall and Footing," no date, Drawing No. 143/41031.
- 2.* ".....Detail of Pier Bases, East & West Porches also Porte Cochere/Plan of Return of Base to Wall," June 28, 1926, Drawing No. 143/41031.
- 3.* ".....Detail of Pier Bases, East & West Porches," June 28, 1926, Drawing No. 143/41031.
- 4.* ".....Detail of Pier Bases, East & West Porches & Porte Cochere," June 28, 1926, Drawing No. 143/41031.

Tile

- 1.* Floor tile layouts, "Typical Bed Room" and "Typical Living Room", January 10, 1927, Drawing No. 143/41035, sheet 19 of 27. C. A. MacNeilledge office drawing also with Alhambra Kilns, Inc., Alhambra, Calif. [One copy of this drawing is annotated as if it were for the Guest House.]
- 2.* "Details of Metal Frames for Tile Radiator Grilles in Music Room", no date, Drawing No. 143/41031, sheet 94 of 159.
- 3.* "Detail for Installation of Radiator Grilles in Music Room", no date, Drawing No. 143/41031, sheet 95 of 159.
- 4.* Details for "Living Room Mantel", (Lower Music Room), March 4, 1927, Drawing No. 143/41031, sheet 90 of 159.

- 5.* Room plans and elevations including "Elevations of Annex Bath", no date, Drawing No. 143/41031, sheet 109 of 159.
- 6.* Detail of sun dial on south wall of Annex, April 20, 1929, Drawing No. 143/41031, sheet 9 (9 and 9A) of 159. Also see Drawing No. 143/41031, sheet 39 of 159 for shadow bar.
- 7.* "Details for Swimming Pool": gutter detail and "Tile Layout for Walk Around Pool", November 4, 1930, Drawing No. 143/41031, sheet 51 of 58. Similar also in Drawing No. 143/41030B, sheet 17 of 28.
- 8.* "Revised Scumgutter Section" for pool, January 20, 1931, Drawing No. 143/41030, sheet 50 of 58.
- 9.* Pool details, January 22, 1931, Drawing No. 143/41030, sheet 49 of 58.
- 10.* ".....Ornamental Border to Swimming Pool", Hispano-Moresque Tile Co., no date, drawing not numbered but in 143/41000 series.

Observation Tower Deck

- 1.* Details of Tower, Main House, Drawing No. 143/41029, Sheet 10 of 41, February 15, 1927. (Drawing also in Structural Section of this report). Also 143/41029B, Sheet 23 of 36, February 15, 1927.

Wood

Gates.

- 1.* Patio gates, April 4, 1929, Drawing No. 143/41031, sheet 36 of 159. (Also 143/41031A, sheet 28 of 48.)
- 2.* ".....Gates on South Side of Patio", April 8, 1929, Drawing No. 143/41031, sheet 129 of 159.
3. "Detail of Gate on North Side of Patio", March 28, 1929, Drawing No. 143/41031, sheet 132 of 159.

Note: These drawings also pertain to metals and color.

Lanai.

- 4.* Details of Lanai screen enclosure, no date, Drawing No. 143/41029, sheet 13 of 49.

Main House, Great Hall Gallery and Alcoves, Scott's Room

- 5.* "Details of Galleries", January 27, 1926, Drawing No. 143/41029, sheet 20 of 41. (Also 143/41031A, sheet 32 of 48, blueprint; sheet 48 of 48 similar.)

- 6.* Details of woodwork including southeast alcove, Great Hall, and ceiling of Scott's Room, February 17, 1927, Drawing No. 143/41029, sheet 14 of 41. (Also see 143/41029B, sheet 21 of 36, incomplete, and sheet 32 of 36.)

Kitchen

7. Kitchen plan and details, no date, Drawing No. 143/41029, sheet 11 of 41. (Also 143/41029B, sheet 30 of 36.)
8. "Kitchen Details", March 4, 1927, Drawing No. 143/41029, sheet 12 of 41. (Also 143/41029B, sheet 31 of 36.)
9. "Detail of Refrigerator Screen and Cupboards in Kitchen", no date, Drawing No. 143/41031, sheet 120 of 159. (Also 143/41031B, sheet 40 of 41.)

Dining Room

- 10.* Dining Room bay and ceiling, January 24, 1927, Drawing No. 143/41029, sheet 18 of 41. (Also 143/41029B, sheet 18 of 36.)
11. "Redwood Bookcases in Library" (Dining Room), June 6, 1927, Drawing No. 143/41029, sheet 23 of 41.

Lower Music Room

- 12.* Details, Lower Music Room, February 5, 1927, Drawing No. 143/41029, sheet 17 of 41. (Also 143/41029B, sheet 19 of 36, marked "void"; and 143/41029C, sheet 2 of 8, blueprint.)
13. Frieze lettering, Lower Music Room, January 31, 1927, Drawing No. 143/41031, sheet 78 of 159, 2 sheets.

Solarium

- 14.* "Solarium Details", February 22, 1927, revised October 14, 1927, Drawing No. 143/41029, sheet 16 of 41.

Upper Music Room

- 15.* "Details of Music Room", including east wall, December 31, 1927, Drawing No. 143/41029. (See also 143/41031B, sheet 25 of 48.)
- 16.* "Details of Music Room", including west wall, December 31, 1927, Drawing No. 143/41029, sheet 60 of 159.

17. "Details of Music Room", south wall, December 31, 1927, Drawing No. 143/41031, sheet 61 of 159.
- 18.* Details of ".....Truss, Frieze, Valance, Pilaster, Etc. at Orchestra Opening in Music Room", December 30, 1927, Drawing No. 143/41031, sheet 6 of 159.
19. Structural details, Upper Music Room, no date, Drawing No. 143/41031, sheet 106 of 159. (See also 143/41031A, sheet 2 of 48.)
20. Details, Upper Music Room, March 2, 1928, Drawing No. 143/41031, sheet 62 of 159.
- 21.* ".....Details of Frieze in Orchestra", Upper Music Room, March 23, 1928, Drawing No. 143/41031, sheet 93 of 159.
22. ".....Details of Mill Work for Music Room Frieze, Orchestra Cornice, Etc.", no date, Drawing No. 143/41031, sheet 96 of 159.
23. ".....Details of Organ Grille in Music Room", no date, Drawing No. 143/41031, sheet 16 of 159.
24. ".....Details of Organ Grille in Music Room", October 21, 1927, Drawing No. 143/41031, sheet 5 of 159.
25. "Det[ail] of Organ Console & Alteration of Orchestra Wall to Install Same", June 4, 1929, Drawing No. 143/41031, sheet 59 of 159.
26. ".....Detail of Spandrel over Door from Music Room to Lanai", March 21, 1928, Drawing No. 143/41031, sheet 88 of 159.

Mrs. Johnson's Apartment

27. Plan and elevations, Mrs. Johnson's Apartment, April 19, 1927, Drawing No. 143/41029, sheet 15 of 41.
28. "Cupboard in Kitchenette", no date, Drawing No. 143/41029, sheet 40 of 41.

Doors

29. "Main Entrance Doors", Main House, January 11, 1927, Drawing No. 143/41029, sheet 37 of 41. (Also 143/41029B, sheet 17 of 36.)
30. ".....Detail of Main Entrance Door in Music Room Tower", no date, Drawing No. 143/41031, sheet 126 of 159.
- 31.* "Screen Door Details", no date, Drawing No. 143/41031, sheet 89 of 159.
32. Door details, April 18, 1927, Drawing No. 143/41029, sheet 8 of 41.
- 33.* Door and window panel details, June 25, 1926, Drawing No. 143/41029, sheet 24 of 41. (Also 143/41029B, sheet 15 of 36.)

34. "Typical Details for Doors in West Wall of Music Room", no date, Drawing No. 143/41031, sheet 47 of 159.

Windows

35. Window details, January 11, 1927, Drawing No. 143/41029, sheet 33 of 41. (Also 143/41029B, sheet 13 of 36, blueprint.)
36. "Window Details", January 11, 1927, Drawing No. 143/41029, sheet 32 of 41. (Also 143/41029B, sheet 12 of 36, blueprint.)
- 37.* "Balcony Windows", Main House, January 11, 1927, Drawing No. 143/41029, sheet 1 of 41. (Also see 143/41029B, sheet 14 of 36, blueprint?).

Metals and Glass

Doors.

- 1.* ".....Details of Doors Bet[ween] Hall & Living Room of Guest Annex," February 28, 1928, Drawing No. 143/41031; also 143/41035, sheet 6 of 27; and 143/41031A, sheet 35 of 48, which indicates 3/8" rod through door, not 5/8" tubing.
2. "Details of Doors in East Wall of Music Room," no date, Drawing No. 143/41031, sheet 7 of 159.
- 3.* ".....Details for Entrance Door in Music Room Tower," December 28, 1928, Drawing No. 143/41031, sheet 13 of 159.
4. "Detail of Door Between Music Room & Tower," October 28, 1927, Drawing No. 143/41031, sheet 82 of 159.
5. ".....Hinge for Entrance Door in Music Room Tower," February 6, 1929, Drawing No. 143/41031, sheet 134 of 159.
- 6.* "Entrance Door in Music Room Tower," January 21, 1929, Drawing No. 143/41031, sheet 139 of 159; also 143/41031A, sheet 4 of 48.
- 7.* "Miscellaneous Hardware," [Screen Door Hardware], Earle Hardware Mfg. Co., Los Angeles, Calif., no date, Drawing No. 143/41035, sheet 4 of 27. [This drawing and the following two are examples that appear to be Earle Hardware Co. catalogue drawings for hardware that (a) may have been already available and made to order by the company, or (b) designed by MacNeilledge's office with future production rights given to the hardware company.]
- 8.* "Marine Design Hardware," [Hardware for Sea Horse Room Door], Earle Hardware Mfg. Co., Los Angeles, Calif., no date, Drawing Nos. 143/41035, sheets 5 and 13 of 27.
9. Door hardware, no date, Drawing No. 143/41035, sheet 23 of 27, with stamp of Western Metal Crafts Co., Inc., Los Angeles. Probably a shop drawing.

10. Door hardware, no date, Drawing No. 143/41035, sheets 26 and 27 of 27.

Windows.

- 11.* ".....Detail of Curtain Rod in Living Room," November 28, 1928, Drawing No. 143/41031, sheet 35 of 159.
12. "Bracing of Curtain Rod in Living Room," March 28, ..?.., Drawing No. 143/41031, sheet 133 of 159.
- 13.* "Curtain Rod Det[ai]l for French Door in Music Room," November 26, 1928 and January 31, 1929, Drawing No. 143/41031, sheet 137 of 159.
14. Metal window details, Detroit Steel Products Co., Detroit, Mich., no date, Drawing No. 143/41035, sheet 20 of 27. Most likely a shop drawing.

Fireplaces

15. Fireplace details, no date, Drawing No. 143/41029B, sheet 20 of 36; also 143/41029, sheet 36 of 41, September 15, 1926.

Structural

16. "Structural Cross Section thru Music Room," November 15, 1927, Drawing No. 143/41031, sheet 98 of 159; also 143/41031A, sheet 11 of 48. Shows tie rods.

Electrical

17. ".....Lighting Fixture for Old Laundry Guest Room," no date, Drawing No. 143/41031, sheet 8 of 159.
- 18.* Light fixture, "Main Kitchen," October 2, 1928, Drawing No. 143/41031, sheet 20 of 159.
19. Light fixture, "Main Kitchen," no date, Drawing No. 143/41031, sheet 21 of 159.
20. ".....Light over Sink, Mrs. Johnson's Kitchen," no date, Drawing No. 143/41031, sheet 22 of 159.
- 21.* ".....Fixtures for Mrs. Johnson's Day Bed," no date, Drawing No. 143/41031, sheet 23 of 159.
22. Wall fixture, "Main Kitchen," no date, Drawing No. 143/41031, sheet 24 of 159.
23. ".....Lantern - Arched Recesses - Living Room," no date, Drawing No. 143/41031, sheet 25 of 159.
24. Wall fixture, "Mrs. Johnson's Bath," no date, Drawing No. 143/41031, sheet 26 of 159.

25. Wall fixture, "Annex Bath Room," no date, Drawing No. 143/41031, sheet 28 of 159.
26. Ceiling fixture, "Mr. Johnson's Bath," no date, Drawing No. 143/41031, sheet 29 of 159.
27. Ceiling fixture, "West Apt. Bath," no date, Drawing No. 143/41031, sheet 30 of 159.
28. Wall fixture, "Main Kitchen Sink," October 3, 1928, Drawing No. 143/41031, sheet 31 of 159.
29. Light fixture, "Top of Patio Stairs," no date, Drawing No. 143/41031, sheet 43 of 159.
30. Wall fixture, "Annex Living Room," no date, Drawing No. 143/41031, sheet 45 of 159.
Drawing contains note: "Finish Old Iron."
31. Wall fixture, "West Apt. Bath," no date, Drawing No. 143/41031, sheet 46 of 159.
32. Wall fixture, "Top of Tower Stairs," no date, Drawing No. 143/41032B, sheet 7 of 7; also 143/41031, sheet 32 of 159.
33. Switch plates, Aztec Forged Hardware Co., Los Angeles, no date, Drawing No. 143/41035, sheet 1 of 27.
- 34.* Switch plates, Aztec Forged Hardware Co., Los Angeles, no date, Drawing No. 143/41035, sheet 2 of 27.
35. Switch plates, Aztec Forged Hardware Co., Los Angeles, no date, Drawing No. 143/41035, sheet 3 of 27.

Stairs, Railings, Screens, Gates and Other Features

- 36.* Grills, railings and stair, April 15, 1927, Drawing No. 143/41021, sheet 19 of 41.
37. "Details of Tower," [Main House], February 15, 1927, Drawing No. 143/41029B, sheet 23 of 36.
38. "Details of Music Room, North Wall," December 31, 1927, Drawing No. 143/41_?_.
39. "Revised South Wall of Music Room," no date, Drawing No. 143/41031.
40. ".....[Detail] for Additional Sections of Iron Screen Around Organ Console," January 7, 1929, Drawing No. 143/41031, sheet 2 of 159.
- 41.* ".....Details of Hardware,.....of Gates on North & South Sides of Patio," April 6, 1929, Drawing No. 143/41031, sheet 10 of 159. (Only one-half of drawing is reproduced).
42. ".....Details of Hardware, Etc., of East & West Gates to Patio," April 8, 1929, Drawing No. 143/41031, sheet 11 of 159.
43. ".....Details of Grills for Interior of Windows on South Wall of Music Room," no date, Drawing No. 143/41031, sheet 12 of 159; also 143/41031A, sheet 45 of 48.

44. Burro weather vane, no date, Drawing No. 143/41031, sheet 15 of 159.
45. ".....[Detail] for Iron Screen Around Organ Console," no date, Drawing No. 143/41031, sheet 19 of 159.
46. ".....[Detail] of Shadow Bar & Plate for Sundial," April 25, 1929, Drawing No. 143/41031, sheet 39 of 159.
47. Window grills, Upper Music Room, no date, Drawing No. 143/41031, sheet 87 of 159.
48. "Det[ail] of Copper Weather Vane on Guest Annex," no date, Drawing No. 143/41031, sheet 121 of 159.
- 49.* ".....Typical Wrot Iron Center Panels of Patio Entrance Gates," March 15, 1929, Drawing No. 143/41031, sheet 125 of 159.
50. "Detail of Wrought Iron Screen for Organ Console," December 18, 1928, Drawing No. 143/41031, sheet 135 of 159; also 143/41031A, sheet 17 of 48.
- 51.* "Wrought Iron Screen for Organ Console," January 31, 1929, Drawing No. 143/41031, sheet 136 of 159.
52. "Wrought Iron Screen for Organ Console," December 18, 1928, Drawing No. 143/41031, sheet 141 of 159.
53. Organ console screen, no date, Drawing No. 143/41031, sheet 146 of 159.
- 54.* "Detail of Patio Gates," April 4, 1929, Drawing No. 143/41031A, sheet 28 of 48; also 143/41031, sheet 36 of 159.
55. Detail of metal elements of furniture, no date, Drawing No. 143/41032, sheet 40 of 68.

Fountains

- 1.* Great Hall Fountain, July 25, 1927, Drawing No. 143/41029, sheet 22 of 41.
- 2.* Great Hall Fountain, Section, no date, Drawing No. 143/41031, sheet 80 of 159.
- 3.* Entry Court Fountain, Feb. 10, 1931, Drawing No. 143/41031B, sheet 24 of 41; Drawing No. 143/41031A, sheet 3 of 48 similar.
- 4.* Entry Court Fountain, June 8, 1931, Drawing No. 143/41033A, sheet 1 of 6. A de Dubovay drawing.
- 5.* An Entry Court pebble paving design, unexecuted, Feb. 2, 1931, Drawing No. 143/41031B, sheet 22 of 41. Others designs which were developed are: Drawing No. 143/41028, sheets 1, 42, 43, 44, 45, 46 and 47 of 59; and Drawing No. 143/41028A, sheet 2 of 26.
- 6.* Sketch of Courtyard Fountain, no date, Drawing No. 143/41028C, sheet 58 of 88.
- 7.* Details of Courtyard Fountain, no date, Drawing No. 143/41031A, sheet 12 of 48.



As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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